Department for Education

Design and technology

Draft GCE AS and A level subject content

July 2015

Contents

Content for design and technology

Introduction

1. The AS and A level subject content sets out the knowledge, understanding and skills common to all AS and A level specifications in design and technology, to ensure progression from key stage 4 and the possibility of development on to further study. It provides the framework within which awarding organisations create the detail of the subject specification. GCE specifications in design and technology must reflect the subject aims and objectives.

Aims and objectives

2. Design and technology is an inspiring, rigorous and practical subject. Courses should enable students to identify market needs for new products, to initiate and develop design solutions, and to make and test prototypes/products[1]. Specifications in design and technology should encourage students to use creativity and imagination to develop and modify designs, and to design, and make prototypes/products that solve real and relevant problems, considering their own and others' needs, wants and values. Students should acquire subject knowledge in design and technology that extends the potential development of a product beyond prototyping and into realisation through to commercial manufacture.

3. Students should take every opportunity to integrate and apply their understanding and knowledge from other subject areas studied during key stage 4, with a particular focus on science and mathematics, and those subjects they are studying alongside GCE design and technology.

4. Due to the need for students to demonstrate expertise in depth in specialist areas three subject endorsements are available, linked to design disciplines that reflect possible higher education routes and industry.

5. Whilst courses at AS and A level will build upon previous study undertaken at key stages 3 and 4 there is no assumption that students will have taken a GCSE course in the subject.

6. All specifications must encourage students to:

[1]The term 'product' is understood throughout to be a generic term for all final outcomes of design practice including systems and objects. The term 'prototype' refers to a design outcome which is a preliminary version of a product from which other forms may be developed.

- be open to taking design risks, showing innovation and enterprise whilst considering their role as responsible designers and citizens
- develop intellectual curiosity about the design and manufacture of products and systems, and their impact on daily life and the wider world
- work collaboratively to develop and refine their ideas, responding to feedback from users, peers and expert practitioners
- gain an insight to the creative, engineering and/or manufacturing industries
- develop the capacity to think creatively, innovatively and critically through focussed research and the exploration of design opportunities arising from the needs, wants and values of users and clients
- develop knowledge and experience of real world contexts for design and technological activity
- develop an in-depth knowledge and understanding of materials, components and processes associated with the creation of products that can be tested and evaluated in use
- be able to make informed design decisions
- be able to analyse a design concept and use a range of skills and knowledge from other subject areas, including mathematics and science, to inform decisions in design and the application or development of technology
- be able to work safely and skilfully to produce high-quality prototypes/products
- have a critical understanding of the wider influences on design and technology, including cultural, economic, environmental, historical and social factors
- develop the ability to draw on and apply a range of skills and knowledge from other subject areas, including the use of mathematics and science for analysis and informing decisions in design

Subject content

7. AS and A level specifications in design and technology must specify that students engage in both practical and theoretical study in design and technology, undertaking iterative problem solving activities, in response to realistic contexts, which result in products/prototypes that can be tested and evaluated in use.

8. All AS and A level specifications in design and technology must require students to cover the design and technology skills, knowledge and understanding as set out below. These have been separated into:

- technical knowledge and understanding
- designing and making principles

9. AS specifications must require students to undertake at least three discrete practical activities that between them enable their skills, knowledge and understanding of design and technology to be demonstrated. Students will apply the designing and making

principles and their knowledge and skills related to the technical knowledge and understanding specified below.

10. At A level there is a minimum expectation that students undertake a substantial design, make and evaluate project that fully exemplifies their skills, knowledge and understanding of design and technology. The project should be of sufficient complexity and offer an appropriate degree of uncertainty of outcome to allow students to demonstrate their abilities in the iterative processes of designing, making, testing, refining, improving and evaluating. Specifications must require students to reflect practices from the creative, engineering and/or manufacturing industries when creating their design portfolios.

Specification titles

11. Design and technology specifications may offer one or more of the endorsed titles listed below. The endorsed titled should prepare students for tertiary education and/or work-based study and training in the creative, engineering and/or manufacturing industries:

- design and technology (product design). This is concerned with the design, development and realisation of domestic and commercial products that meet the needs and wants of users and clients
- design and technology (fashion design and development). This is concerned with the design, development and realisation of products for the fashion, clothing and textiles industries
- design and technology (engineering). This is concerned with the design, development, construction and use of control systems, machines, devices and structures

12. The subject content has been arranged to define a core content of knowledge and understanding applicable to all AS and A level specifications with additional content for each endorsed title.

Core technical knowledge and understanding

13. All AS and A level specifications must require students to demonstrate the mathematical and scientific knowledge, understanding and skills set out in appendix 1.

14. Specifications must require students to develop knowledge and understanding of:

- how manufactured products typically involve multiple materials, processes and techniques and that designers need to be able to discriminate between them and select them appropriately for use, experimenting in order to improve, refine and realise a design

- the requirements for product design, development and manufacture, including: fitness for purpose; meeting the criteria of specifications; accuracy of production; appropriate use of technology; aesthetics; ergonomics and anthropometrics
- the use of media and techniques, including sketching, to record, explain and communicate their design decisions, providing sufficient information to enable others to interpret their design intentions
- digital design and digital manufacture, including CAD/CAM, modelling and simulation
- safe working practices, including identifying hazards and understanding the need for risk assessments
- how skills and knowledge from other subject areas, including mathematics and science, inform decisions in design and the application or development of technology

15. In addition, all A level specifications must require students to develop knowledge and understanding of:

- the main features of manufacturing industries, including stages of production, quality assurance and quality control, modern manufacturing methods and systems when combining or processing materials, sustainability and services to the customer, including legal requirements
- the regulatory and legislative framework for health and safety
- the use of feasibility studies on the practicability of proposed solutions to problems
- design for manufacturing, repair or maintenance and product life
- how to achieve an optimum use of materials and components by taking into account the relationship between material, form and manufacturing processes, and the scale of production
- the implications of intellectual property, registered designs, registered trademarks, copyright, design rights and patents
- the role of marketing, enterprise, innovation and collaboration in the development of products

Core designing and making principles

16. All AS and A level specifications must require students to develop knowledge and understanding of:

- the investigation and analysis of a context, and the needs, wants and values of users, to define a design opportunity or problem leading to the production of a design brief and specification to direct, inform and evaluate their design practice
- the application of knowledge and understanding in a product development process to design, make and evaluate prototypes/products

- how the appraisal of technological developments, both current and historic, needs to take into consideration social, moral and ethical factors and how these can impact on the work of designers and technologists
- how to critically analyse and evaluate their own ideas and decisions whilst using iterative design and make processes
- in relation to the subject endorsement, how to select and use safely a range of specialist tools, techniques, processes, equipment and machinery appropriate to the design and manufacture of domestic, commercial and industrial products and systems
- how to measure, determine and apply the degree of accuracy and precision required for products to perform as intended
- how to evaluate their prototypes / products taking into account the views of potential users, customers or clients

17. In addition, all A level specifications must require students to develop knowledge and understanding of:

- the investigation and analysis of a context, and the needs, wants and values of users, to define a design opportunity or problem leading to the production of a design brief and specification to direct, inform and evaluate their design practice
- a range of strategies, techniques and approaches to explore, create and evaluate design ideas, such as user-centred design, circular economy and systems thinking
- approaches to project management, such as critical path analysis, scrum or six sigma
- design for manufacture, including planning for accuracy and efficiency when making prototypes and making recommendations for small, medium and large scale production
- the environmental factors affecting disposal of waste, surplus materials, components and by-products; sustainability and costs
- the application of relevant standards to their design tasks including those published by the British Standards Institute (BSI) and the International Organisation for Standardisation (ISO) specific to the subject
- the stages of a product life cycle

Additional specialist knowledge

Product design

18. All A and AS level design and technology (product design) specifications must require students to have knowledge and understanding of:

- the characteristics and working properties of materials relevant to product design and manufacture, including metals, woods, polymers, textiles, composites, smart and modern materials

- the use of adhesives, permanent and semi-permanent fixings
- the use of surface finishes and coatings to enhance appearance and methods of preventing corrosion and decay such as paints, varnishes, sealants, preservatives, anodising, plating, coating, galvanization and cathodic protection
- the performance characteristics of woods, metals and polymers including tensile strength, elasticity, resilience and durability
- the application of smart and modern materials
- production processes including moulding, extrusion, laminating, milling, turning, casting, stamping and forming; the use of ICT, prototyping, jigs and fixtures

19. In addition, all A level design and technology (product design) specifications must require students to have a knowledge and understanding of:

- industrial and commercial practice including manufacturing processes and systems, product manufacture and maintenance, production scales and quality control in relation to manufacturing and the design industries
- modular/ cell production systems, just-in-time manufacturing, bought-in parts and components and the use of standardised parts
- rapid prototyping

Fashion design and development

20. All A and AS level design and technology (fashion design and development) specifications must require students to have knowledge and understanding of:

- the characteristics and working properties of materials relevant to fashion design and development including the source and classification of the main fibre groups, yarns, mixtures, blends and laminates
- fabric and component manufacture including the structure and main construction methods, and the differences between them
- the working properties of fibres and fabrics, and their physical characteristics in relation to their choice for various design solutions
- the performance characteristics of fibres including tensile strength, elasticity, resilience, durability, flammability and weight
- the qualities given to the fabrics by the construction methods, including typical end uses, fabric finishes and surface decoration, and surface pattern technologies
- the applications of smart materials, e-textiles and technical textiles
- how materials, other than fibres and fabrics, can be used in fashion design and development
- a variety of components and their appropriateness for a range of products in relation to the end-user, fabric and design considerations

21. In addition, all A level design and technology (fashion design and development) specifications must require students to have a knowledge and understanding of:

- industrial and commercial practice including manufacturing processes, the use of ICT, pattern cutting, product manufacture and repair, production scales and quality control in relation to textiles and the fashion industry
- the use of pattern drafting, toiles and testing systems

Engineering

22. All A and AS level design and technology (engineering) specifications must require students to have knowledge and understanding of:

- the characteristics and working properties of materials relevant to engineering including metals, woods, polymers, composites, smart and modern materials
- electrical, electronic, mechanical, hydraulic and pneumatic systems including input devices, processing devices and techniques, output devices and power sources
- these will include devices to sense light, heat, sound and pressure, logic gates, counters, amplifiers, microcontrollers, display devices and regulated power supplies
- structures, including the forces of tension, compression, torsion and bending; stress, strain and elasticity; rigidity and modes of failure
- mechanisms including gear and transmission systems, cams and linkages
- programmable and control devices including how to use such devices to solve problems in system design
- how to represent systems and components through the use of circuit diagrams, flowcharts and constructional diagrams
- how to develop and use production plans

23. In addition, all A level design and technology (engineering) specifications must require students to have a knowledge and understanding of:

- industrial and commercial practice including manufacturing processes and systems, the use of ICT, prototyping, product manufacture and maintenance, production scales and quality control in relation to the engineering industries
- how to interface electrical/electronic circuits with mechanical and pneumatic systems and components
- communication protocols, including an understanding of interfacing with wireless devices, embedded devices and smart objects
- product lifecycle management, engineered lifespans including planned obsolescence, the need for maintenance of machinery, product support and end of life (EOL)
- the use of destructive and non-destructive testing
- the prediction of performance through modelling, including the use of IT based tools

Appendix 1: mathematics and science

All AS and A level specifications in design and technology must require students to demonstrate their application of knowledge, understanding and skills of mathematics and science in both theoretical and practical ways.

Design and technology uses mathematics and science to support decisions made in the processes of designing and making.

Mathematics

Ref	Mathematical skills requirement	Potential design and technology applications		
		Product Design	Fashion	Engineering
a	Confident use of number and percentages	Calculation of quantities of materials, costs and sizes	Calculation of quantities of materials, costs and sizes	Calculation of quantities of materials, components, costs and sizes
b	Use of ratios	Scaling drawings	Scaling patterns for different sizes of garments	Scaling drawings
c	Calculation of surface areas and volumes	Determining quantities of materials	Determining quantities of materials	Determining quantities of materials
d	Use of trigonometry	Calculation of sides and angles as part of product design	Calculation of sides and angles as part of fashion product design	Projectile motion. Oscillations in mechanical and electronic contexts including resonance. Representation of frequency, period, amplitude and phase
e	Construction and analysis of graphs and charts	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research	Representation of data used to inform design decisions and evaluation of outcomes. Presentation of market data, user preferences, outcomes of market research	Representation of data used to inform design decisions and evaluation of outcomes. Velocity-time graphs. Stress-strain and resistance-temperature graphs

f	Knowledge of applications of calculus (A level only)			Awareness of optimum values and use of differentiation and integration in the context of engineering analysis and problem solving such as the calculation of maximum volumes of a box using a minimum amount of material
g	Use of coordinates and geometry	Use of datum points and geometry when setting out design drawings	Use of datum points and geometry when setting out patterns	Use of datum points and geometry within engineering drawings
h	Use of statistics and probability as a measure of likelihood	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine product scale and dimensions	Interpret statistical analyses to determine user needs and preferences. Use data related to human scale and proportion to determine required sizes and dimensions of fashion products	Understanding of dimensional variations in mass produced components. Defects in batches and reliability linked to probabilities

Science

Ref	Scientific knowledge and skills	Potential design and technology applications		
		Product Design	Fashion	Engineering
a	Use scientific laws - Newton's laws of motion, Hooke's law, Ohm's law as appropriate to the designed product			Applied to electronic circuit design, projectiles, linear and circular movement of objects under the influence of forces, problems involving stress, strain and elasticity
b	Describe the conditions which cause corrosion and the process of oxidisation	Ensure products are designed to take account of potential corrosion due to environmental factors	Ensure fashion products are designed to take account of potential corrosion due to environmental factors	Ensure engineering products are designed to take account of potential corrosion due to environmental factors
c	Know the composition of important composites and polymers in relation to their properties and uses	Select and use alloys appropriate to product design, development and manufacture	Select and use alloys appropriate to fashion product design, development and manufacture	Select and use alloys appropriate to engineering product design, development and manufacture. Understand how the composition of alloys determines their physical and working properties
d	Know the physical properties of materials and explain how these are related to their uses	Select and use materials, including glass and clay ceramics, polymers, composites, woods and metals, based on their physical properties	Select and use materials, including textiles, fibres, polymers, technical textiles, ceramics and metals, based on their physical properties	Select and use materials, including ceramics, polymers, composites, woods and metals based on their physical properties

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