

SYLLABUS

**Cambridge International AS and A Level
Design and Technology**

9705

For examination in November 2016

Changes to syllabus for 2016

This syllabus has been updated, but there are no significant changes.

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1. Introduction

1.1 Why choose Cambridge?

Recognition

Cambridge International Examinations is the world's largest provider of international education programmes and qualifications for learners aged 5 to 19. We are part of Cambridge Assessment, a department of the University of Cambridge, trusted for excellence in education. Our qualifications are recognised by the world's universities and employers.

Cambridge International AS and A Levels are recognised around the world by schools, universities and employers. The qualifications are accepted as proof of academic ability for entry to universities worldwide, though some courses do require specific subjects.

Cambridge International A Levels typically take two years to complete and offer a flexible course of study that gives learners the freedom to select subjects that are right for them.

Cambridge International AS Levels often represent the first half of an A Level course but may also be taken as a freestanding qualification. The content and difficulty of a Cambridge International AS Level examination is equivalent to the first half of a corresponding Cambridge International A Level. Cambridge AS Levels are accepted in all UK universities and carry half the weighting of an A Level. University course credit and advanced standing is often available for Cambridge International AS and A Levels in countries such as the USA and Canada.

Learn more at www.cie.org.uk/recognition

Excellence in education

Our mission is to deliver world-class international education through the provision of high-quality curricula, assessment and services.

More than 9000 schools are part of our Cambridge learning community. We support teachers in over 160 countries who offer their learners an international education based on our curricula and leading to our qualifications. Every year, thousands of learners use Cambridge qualifications to gain places at universities around the world.

Our syllabuses are reviewed and updated regularly so that they reflect the latest thinking of international experts and practitioners and take account of the different national contexts in which they are taught.

Cambridge programmes and qualifications are designed to support learners in becoming:

- **confident** in working with information and ideas – their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as learners, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Support for teachers

A wide range of support materials and resources is available for teachers and learners in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at **www.cie.org.uk/teachers**

Support for exams officers

Exams officers can trust in reliable, efficient administration of exam entries and excellent personal support from our customer services. Learn more at **www.cie.org.uk/examsOfficers**

Not-for-profit, part of the University of Cambridge

We are a not-for-profit organisation where the needs of the teachers and learners are at the core of what we do. We continually invest in educational research and respond to feedback from our customers in order to improve our qualifications, products and services.

Our systems for managing the provision of international qualifications and education programmes for learners aged 5 to 19 are certified as meeting the internationally recognised standard for quality management, ISO 9001:2008. Learn more at **www.cie.org.uk/ISO9001**

1.2 Why choose Cambridge International AS and A Level?

Cambridge International AS and A Levels are international in outlook, but retain a local relevance. The syllabuses provide opportunities for contextualised learning and the content has been created to suit a wide variety of schools, avoid cultural bias and develop essential lifelong skills, including creative thinking and problem-solving.

Our aim is to balance knowledge, understanding and skills in our programmes and qualifications to enable candidates to become effective learners and to provide a solid foundation for their continuing educational journey. Cambridge International AS and A Levels give learners building blocks for an individualised curriculum that develops their knowledge, understanding and skills.

Schools can offer almost any combination of 60 subjects, and learners can specialise or study a range of subjects, ensuring a breadth of knowledge. Giving learners the power to choose helps motivate them throughout their studies.

Through our professional development courses and our support materials for Cambridge International AS and A Levels, we provide the tools to enable teachers to prepare learners to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge International AS and A Levels have a proven reputation for preparing learners well for university, employment and life. They help develop the in-depth subject knowledge and understanding which are so important to universities and employers.

Learners studying Cambridge International AS and A Levels have the opportunities to:

- acquire an in-depth subject knowledge
- develop independent thinking skills
- apply knowledge and understanding to new as well as familiar situations
- handle and evaluate different types of information sources
- think logically and present ordered and coherent arguments
- make judgements, recommendations and decisions
- present reasoned explanations, understand implications and communicate them clearly and logically
- work and communicate in English.

Guided learning hours

Cambridge International A Level syllabuses are designed on the assumption that learners have about 360 guided learning hours per subject over the duration of the course. Cambridge International AS Level syllabuses are designed on the assumption that learners have about 180 guided learning hours per subject over the duration of the course. This is for guidance only and the number of hours required to gain the qualification may vary according to local curricular practice and the learners' prior experience of the subject.

1.3 Why choose Cambridge International AS and A Level Design and Technology?

This syllabus encourages candidates to be innovative and creative and to develop their ability to design high quality products. Through their studies, candidates will:

- develop an awareness of the significance of design and technology to society
- learn more about production processes and industrial practices
- develop critical evaluation skills which they can employ in a variety of technical, aesthetic, economic, environmental, social and cultural contexts.

As a result, candidates will also become discerning consumers of design and technology, able to make informed choices.

Prior learning

We recommend that candidates who are beginning this course should have previously completed a Cambridge O Level or Cambridge IGCSE course in Design and Technology or the equivalent.

Progression

Cambridge International A Level Design and Technology provides a suitable foundation for the study of Design and Technology or related courses in higher education. Equally it is suitable for candidates intending to pursue careers or further study in Design and Technology, or as part of a course of general education.

Cambridge International AS Level Design and Technology constitutes the first half of the Cambridge International A Level course in Design and Technology and therefore provides a suitable foundation for the study of Design and Technology at Cambridge International A Level and thence for related courses in higher education. Depending on local university entrance requirements, it may permit or assist progression directly to university courses in Design and Technology or some other subjects. It is also suitable for candidates intending to pursue careers or further study in Design and Technology, or as part of a course of general education.

1.4 Cambridge AICE (Advanced International Certificate of Education) Diploma

Cambridge AICE Diploma is the group award of the Cambridge International AS and A Level. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of candidates who pass examinations in three different curriculum groups:

- Mathematics and Science (Group 1)
- Languages (Group 2)
- Arts and Humanities (Group 3)

A Cambridge International A Level counts as a double-credit qualification and a Cambridge International AS Level counts as a single-credit qualification within the Cambridge AICE Diploma award framework.

To be considered for an AICE Diploma, a candidate must earn the equivalent of six credits by passing a combination of examinations at either double credit or single credit, with at least one course coming from each of the three curriculum groups.

Design and Technology (9705) is in Group 1, Mathematics and Sciences.

Credits gained from Cambridge AS Level Global Perspectives (8987) or Cambridge Pre-U Global Perspectives and Independent Research (9766) can be counted towards the Cambridge AICE Diploma, but candidates must also gain at least one credit from each of the three curriculum groups to be eligible for the award.

Learn more about the Cambridge AICE Diploma at www.cie.org.uk/qualifications/academic/uppersec/aice

The Cambridge AICE Diploma is awarded from examinations administered in the June and November series each year.

1.5 How can I find out more?

If you are already a Cambridge school

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at info@cie.org.uk

If you are not yet a Cambridge school

Learn about the benefits of becoming a Cambridge school at www.cie.org.uk/startcambridge. Email us at info@cie.org.uk to find out how your organisation can register to become a Cambridge school.

2. Teacher support

2.1 Support materials

Cambridge syllabuses, past question papers and examiner reports to cover the last examination series are on the *Syllabus and Support Materials* DVD, which we send to all Cambridge schools.

You can also go to our public website at **www.cie.org.uk/alevel** to download current and future syllabuses together with specimen papers or past question papers and examiner reports from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabuses is available from Teacher Support, our secure online support for Cambridge teachers. Go to **<http://teachers.cie.org.uk>** (username and password required).

2.2 Resource lists

We work with publishers providing a range of resources for our syllabuses including textbooks, websites, CDs, etc. Any endorsed, recommended and suggested resources are listed on both our public website and on Teacher Support.

The resource lists can be filtered to show all resources or just those which are endorsed or recommended by Cambridge. Resources endorsed by Cambridge go through a detailed quality assurance process and are written to align closely with the Cambridge syllabus they support.

2.3 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See **www.cie.org.uk/events** for further information.

3. Assessment at a glance

Cambridge International AS Level candidates take only Components 1 and 2.

Cambridge International A Level candidates have two choices. Candidates who want to take the whole of the Cambridge International A Level qualification at the end of a course of study take all four components together. Candidates who want to take the Cambridge International A Level qualification in two stages take the Cambridge International AS Level first. If they pass Cambridge International AS Level, they then only need to take Components 3 and 4 in order to complete the Cambridge International A Level.

Cambridge International AS Level

Component 1	3 hours	Component 2	40–50 hours
This is a written paper which tests knowledge, understanding, product analysis and design. There are three sections; in each section candidates answer one question from a choice of three.		This is a coursework project which involves an individual design problem and production of a design model.	
Weighted at 60% of total marks		Weighted at 40% of total marks	

Cambridge International A Level

Component 1	3 hours	Component 2	40–50 hours
Component 1 for Cambridge International A Level is the same as Component 1 for Cambridge International AS Level.		Component 2 for Cambridge International A Level is the same as Component 2 for Cambridge International AS Level.	
Weighted at 30% of total marks		Weighted at 20% of total marks	
Component 3	3 hours	Component 4	40–50 hours
This is a written paper which tests design, knowledge and understanding in three focus areas; candidates specialise in one of these areas. There are two sections in this paper. In Section A candidates answer two structured knowledge application questions from a choice of three on their chosen focus area. In Section B candidates answer the one design question on their chosen focus area.		This is a coursework project, and it can either be developed from the Component 2 project or be a completely new project covering Components 2 and 4 in an holistic way.	
Weighted at 30% of total marks		Weighted at 20% of total marks	

Availability

This syllabus is examined in the October/November examination series.

This syllabus is not available to private candidates.

Detailed timetables are available from **www.cie.org.uk/examsofficers**

Centres in the UK that receive government funding are advised to consult the Cambridge website **www.cie.org.uk** for the latest information before beginning to teach this syllabus.

Combining this with other syllabuses

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabuses with the same title at the same level.

4. Syllabus aims and assessment objectives

4.1 Syllabus aims

The aims of the Cambridge International AS and A Level Design and Technology syllabus are to enable candidates to develop:

- the ability to be innovative and creative in design and technology and to recognise constraints and produce high quality products
- an awareness of the significance of design and technology to society
- the ability to apply essential knowledge, understanding and skills of design production processes to a range of technological activities and develop an understanding of industrial practices
- the ability to use information and communications technology (ICT), as appropriate, to enhance their design and technological capability
- critical evaluation skills in technical, aesthetic, economic, environmental, social and cultural contexts
- the ability to make informed choices as a discerning consumer
- positive attitudes of co-operation and citizenship and the ability to work collaboratively.

4.2 Scheme of assessment

Candidates study compulsory core syllabus content at Cambridge International AS Level (tested in Component 1). At AS and A Levels they also have the opportunity to investigate and develop specialist areas of interest through the coursework projects (Components 2 and 4). The project is a significant part of the teaching and assessment requirements of this syllabus; it is important that candidates have the opportunity to access facilities whereby the realisation of products can be achieved. Cambridge International A Level candidates choose one of the three following focus areas from Part 2 of the syllabus to study (tested in Component 3):

- Product design
- Practical technology
- Graphic products.

Component 1

This question paper tests the compulsory core content of the syllabus (Part 1). There are three sections, which assess knowledge, understanding, product analysis and design. In each section candidates answer one question from a choice of three. Section A contains structured core knowledge application questions; Section B contains product analysis questions; Section C contains structured design questions.

Component 2

This school-based assessment is a coursework project, and it allows candidates to investigate and develop specialist areas of interest. Candidates identify a design problem and then produce a design model. The purpose of the model is to establish the validity of the initial design thinking and synthesis of ideas and their suitability for further development.

Depending on the nature of the project, it is likely that the model will either focus on one or more detailed aspects of design ideas and proposals or represent an overall design idea through a scale model.

The model must consist of a made product formed from one or a combination of kit, resistant or semi-resistant materials.

Computer modelling is not suitable for this section of the project and the outcome is likely to be 3D in nature, although 2D models may be appropriate for certain graphic products. Candidates may use materials outside those specified in the curriculum content (e.g. textiles) but it must be possible to assess the outcome using the coursework assessment criteria in the syllabus. Assessors cannot make any allowance for the use of other materials and candidates will still need to prepare for and respond to the written paper(s) based on the specified curriculum content.

The project is internally marked and externally moderated. There is more information on marking and moderation in Section 6 of this booklet.

Component 3

This question paper tests the focus areas in Part 2 of the syllabus. Candidates choose one of the three focus areas. There are two sections which test design, knowledge and understanding in each of the three focus areas. Section A contains nine structured knowledge application questions covering the three focus areas. Candidates must answer two questions from one focus area. Section B consists of three design questions, covering the three focus areas; candidates must answer one.

Component 4

This school-based assessment is another coursework project. It can be either the natural development of the Component 2 project or a completely new project covering Components 2 and 4 holistically. The outcome of this component will be a product made in the most appropriate materials available. It may be a complete final product, a prototype or camera ready copy, depending on the nature of the project. However, it must be possible to test and evaluate the product in a meaningful way.

The project is internally marked and externally moderated. There is more information on marking and moderation in Section 6 of this booklet.

Because each Centre needs to despatch a sample of the coursework projects to Cambridge for moderation purposes, the design folio should be in paper format no larger than A3 size. Each folio should include sufficient photographs showing an overall view and detailed evidence of the level of achievement reached on the model and/or final product. Centres must not send 3D products to Cambridge for moderation purposes.

Although one of the syllabus aims is to encourage the use of information and communications technology (ICT), this is not a requirement. Candidates who do not use ICT will not lose marks.

4.3 Assessment objectives and their weighting in the exam papers

There are three assessment objectives in Cambridge International AS and A Level Design and Technology:

A Knowledge and understanding

Candidates should be able to demonstrate knowledge and understanding in relation to:

- a range of materials and components used for the production of artefacts
- a range of tools, equipment and associated processes used in design and technological activity
- the impact of design and technology upon society
- communication using a range of graphical techniques including conventions and specialist vocabulary.

B Design analysis, generation of ideas and synthesis

Candidates should be able to:

- prepare a design brief relating to a situation or need
- search out, select and order information relevant to a design problem
- analyse situations of need and produce a specification of requirements, taking account of human, aesthetic, technical and environmental factors
- generate and explore a range of conceptual ideas
- appraise ideas leading to the selection and modelling of a design proposal
- refine and develop in detail a design proposal suitable for implementation, recognising constraints of time, cost and accessible resources.

C Practical implementation

Candidates should be able to:

- plan and organise the procedure to implement a design proposal
- undertake safely and efficiently the practical work to implement a design
- demonstrate refined making skills and the capacity to attend to fine detail
- test and evaluate the product leading to proposals for improvement.

Assessment objective	Component 1	Component 2	Component 3	Component 4	Overall
Knowledge and understanding	15%	–	15%	–	30%
Design analysis, idea generation and synthesis	15%	13%	15%	5%	48%
Practical implementation	–	7%	–	15%	22%
Total	30%	20%	30%	20%	100%

The weighting of the assessment objectives indicates their relative importance. It does not indicate exactly how many marks assessors can give for each assessment objective in each component.

5. Syllabus content

5.1 Part 1 – Core content

All candidates study this compulsory part of the syllabus

Core content	
	<i>All candidates should be able to:</i>
Situation	- recognise problems which a designer can potentially solve through practical design activity - prepare a design brief that accurately describes the need(s)
Research	locate, gather and order information and data relevant to the solution
Specification	- form analysis of the situation - draw up a comprehensive, succinct and detailed specification of requirements
Concepts	- generate and record possible solutions - appraise possible solutions through a variety of techniques leading to the selection of one idea for development
Modelling	model detailed aspects of ideas and proposals using appropriate practical techniques
Development	- develop and formulate a detailed design proposal for production of the final product - identify the resources that they need for the realisation of a solution
Implementation	- organise the resources for realising the product - make the product through the skilful use of appropriate hand and machine tools and other equipment - work at all times with regard to mandatory and other necessary safety measures and with proper concern for the efficient use of materials, energy and other resources
Testing and evaluation	- devise and apply appropriate tests to assess the success of the product against original needs and others which have emerged and the design has absorbed - suggest possible improvements for the product

Design and technology in society	• recognise rational and intuitive approaches to design • show awareness and appreciation of the issues of conservation of resources, built in obsolescence and the role of recycling • demonstrate an appreciation of the significant positive and negative effects of design upon society • show awareness of the differences between individual, small batch and mass production and how each affects the means of production, the product and the people involved
Aesthetics	• use line, colour, shape, proportion and form to achieve desired effects • show appreciation of the effects of light and shade on solid forms and the effects of different surface finishes on visual and tactile senses • demonstrate aesthetic sensibility through meaningful use of appropriate vocabulary, such as: harmony, conflict, static and dynamic • appreciate the significance of style and the influence of fashion and design
Ergonomics	• understand the significance of ergonomics in design • interpret and apply anthropometric data
Energy	• identify and compare the main sources of energy using finite supplies, such as fossil fuels, and regenerative forms such as water, wind and solar • describe the different forms of energy storage in use to include: kinetic, potential, thermal, electrical and chemical • describe practical and efficient methods of conversion and transmission through simple mechanisms, machines, engines, turbines and electric motors
Control	• explain basic principles of manual and semi-automatic and automatic control using input, output, feed-back and amplification • appreciate the principles employed in CAD (computer aided design) and CAM (computer aided manufacture)
Materials	• appreciate the significance of the properties: hardness, ductility, toughness, brittleness, elasticity, dimensional stability, electrical conductivity, corrosion resistance • explain the considerations required in the selection of materials and components to ensure suitability for purpose • explain and compare, through the use of examples, the terms destructive and non-destructive testing of materials • demonstrate a general knowledge of wood, manufactured boards, metals, plastics, paper and card, being able to select them for appropriate use according to their characteristics, properties and performance

Materials processing	• mark and set out with reference to data using tools and methods appropriate to the materials and required accuracy • cut, shape and form materials using methods appropriate to the task • join and assemble using a range of common methods including temporary and permanent fixings • apply a finish appropriate to the material and its use, distinguishing between decoration and protection
Product analysis	• analyse existing products in terms of: – function – aesthetics – ergonomics – types and properties of materials – production techniques – safety
Health and safety	• show awareness of standard risk assessment procedures in product design and manufacture • understand safe working practices, including identifying hazards and making risk assessments

5.2 Part 2 – Product design

This is one of the three optional focus areas for Cambridge International A Level candidates in Part 2 of the syllabus. Centres and candidates can choose to study Product design, Practical technology or Graphic products.

Candidates should learn through practical manipulative experience wherever possible.

Product design	
	<i>Candidates should be able to:</i>
Design stimulus and methodology	• show appreciation of the concepts market-pull and producer-led design • explain how advances in technology impact upon the evolution of design • demonstrate an understanding of the need of designers to consider physical, cultural and aesthetic needs • discuss how product designers, designer craftsmen and engineers shape aspects of the man-made environment • show appreciation of the economic implications of design decision making
Production	• describe the principles of unit and mass production • recognise the influence of industrial production methods upon the design of products
Modelling	• understand the role of different forms of modelling • describe a range of methods of 2D and 3D modelling: kits, computers, mock-ups and scale prototypes
Metal properties	• describe the physical characteristics, working properties and typical applications of: – ferrous: iron, mild steel, carbon steel, high carbon steel – non-ferrous: copper, aluminium, zinc, lead, tin – composite alloys: stainless steel, bronze, brass and duralumin (or similar)

Processing	- describe how to use heat treatment to anneal, harden and temper, and case harden - appreciate the cause and effect of work hardening - explain the process of casting using simple and split patterns - describe the process and explain the use of die-casting - describe the principles of producing forms by rolling, drawing and extruding - shape by: - deforming and reforming using bending and pressing - wastage by hand cutting and shearing - wastage by machine methods including drilling, turning using independent and self centring chucks, end milling for flat surfaces and rebates - join materials using soft and hard soldering, brazing, rivets, threaded fixings - understand the use of gas and electric arc welding - compare the use of a range of surface finishes including painting, polishing, plating, dip coating, enamelling, etching and anodising
Tool technology	- understand the cutting action of lathe, end milling, drilling, sawing and hand-cutting tools - describe the maintenance of cutting edges of simple lathe tools, drills and hand-cutting tools
Wood properties	- describe the physical characteristics, working properties and typical applications of hardwood and softwood - explain the reasons for and describe in outline natural and kiln seasoning - describe and appreciate the significance of warping, twisting and dimensional stability - appreciate the nature and describe the use of veneer - describe the general nature of, and give typical applications for, the following processed boards: - blockboard, plywood, chipboard, hardboard, medium density fibre board

Processing	• prepare, mark and set out using datums • shape, to form straight and curved profiles using a range of hand tools • turn on a lathe using face plate and between centre turning techniques • use a range of boring tools including the drilling machine • describe the use of fences as guides on machines • describe the moulding of simple forms by hand and machine methods • produce surfaces appropriate for a variety of finishes • produce finishes using varnish, paint, oil • assemble and join using a range of frame and carcass (box) constructions • use temporary and permanent fixings including screws, adhesives, nails, wedges and dowels • describe the process of laminating and explain its significance in terms of strength and form
Tool technology	• describe the maintenance of hand tool cutting edges • understand cutting action of sawing, planing and boring hand tools
Plastic properties	• explain the difference between thermoset and thermoplastic materials • describe the working characteristics and properties of the following thermoset plastics and give typical applications: – polyester resin, epoxy resin, melamine • describe the working characteristics and properties of the following thermoplastics and give typical applications: – acrylic, polythene, nylon, PVC, polystyrene, ABS and polypropylene • describe the techniques and effects of using glass and carbon fibres as reinforcement
Processing	• understand the working principles and make judgements regarding their selection and application of calendering, injection moulding, compression moulding, rotational moulding and vacuum forming • shape by hand tools, drilling and turning using a lathe • join with adhesives, solvents and mechanical methods such as screw threads and the use of fixings • describe how to produce and protect polished surfaces
Tool technology	• describe the maintenance of hand and machine tool cutting edges • understand cutting actions of drills, lathe tools and hand tools

5.3 Part 2 – Practical technology

This is one of the three optional focus areas for Cambridge International A Level candidates in Part 2 of the syllabus. Centres and candidates can choose to study either Product design, Practical technology or Graphic products.

Candidates should learn through practical manipulative experience wherever possible.

Practical technology	
	<i>Candidates should be able to:</i>
Technological design and production	- explain how technological developments can affect the design and manufacture of artefacts - understand the terms invention, innovation and evolution - describe the use of CAD (computer aided design) for the storage and retrieval of data and the manipulation of images to aid design, production and management - describe the principal features of CAM (computer aided manufacture) particularly in the control of machines
Materials	- appreciate the significance of the following properties with regard to materials, components and artefacts: - electrical and thermal conductivity, corrosion resistance, toughness, ductility, elasticity, plasticity, brittleness - identify, with reasons, appropriate applications of: - timber, concrete, mild steel, carbon steel, copper, brass, lead, aluminium, thermoplastic and thermoset plastics, rubber, semiconductors - explain the terms alloying and reinforcement - conduct simple experiments to: - determine the relationship between extension and load - compare relative hardness, stiffness and tensile strength - understand Young's Modulus of elasticity, draw a stress/strain graph from given data, and interpret significant features
Processing	- understand the working principles and make judgements regarding the selection and application of metal and plastic casting, injection moulding, compression moulding, vacuum forming, laminating, machining on the lathe - show awareness of die casting, drawing, extruding, blow moulding, rotational moulding - understand the use and application of soft and hard soldering, electric and gas welding, adhesives

Mechanisms	• explain the terms load, effort, mechanical advantage, velocity ratio and efficiency • explain the principles of levers and calculate moments • describe methods of: – converting linear to rotary motion and vice versa including the use of cams, cranks and ratchets – transmitting linear and rotary motion • calculate driver/driven ratios including compound trains • explain the role of friction and lubrication • explain the principles and compare hydraulic and pneumatic systems for linear motion
Structures	• compare and comment on frame and monocoque structures in existing common applications such as buildings, bridges, cranes, furniture, vehicles, machines and the occurrence of structural features in nature • understand how it is possible to reinforce structures by using gussets, ribs, braces and lamination • identify struts and ties in frameworks and recognise where and how it is possible to use triangulation to establish rigidity • apply the concept of equilibrium as a result of applied load and reaction • solve design problems using vector diagrams involving two inclined forces or three forces in equilibrium • apply Bow's notation to assist the resolution of a framework by graphical means
Structural failure	• identify and comment on modes of potential failure in structures and machines including: plastic hinging, buckling, twisting, changes in temperature and fatigue
Testing	• be aware of appropriate methods of non-destructive testing, including strain gauges and photoelasticity • understand and apply simple data from tensile, compressive, shear, bending, torsion and impact tests in design situations
Power sources	• describe the characteristics of AC and DC current • understand the principles of step down/up, rectification, voltage and current regulation • apply Ohm's Law • determine power from known current and voltage • use meters to measure voltage, current and resistance

Electronics and control	• explain the working of the following: – switches including reed, micro switch and relay – transistors (NPN and PNP types) as amplifier and switch and define current gain – a Darlington Pair – capacitors – diodes for rectification and protection against back emf – zeners for voltage reference – LEDs and photodiodes – resistors including stability, tolerance and power rating – transducers including thermistors, strain gauges and LDRs • calculate resistance of series and parallel resistors • determine the values for resistors for a potential divider
Circuits	• draw circuit diagrams including: – switching using the output from op amp to operate transistors and relays. Operational amplifiers based on 741 or similar IC – time delay using an IC such as a 555 • explain the functions of AND, OR, NAND, NOR and XOR • construct truth tables for the above functions • show how it is possible to cross couple two NAND or two NOT gates to produce a flip-flop • be aware of the differences between the TTL and CMOS series of ICs • draw monostable circuits using logic gates and/or 555 timers • describe how to use a Schmitt trigger for inputting from a sensor • be aware of the functioning of a digital-analogue converter • understand the principles of interfacing between a computer and input and output devices

5.4 Part 2 – Graphic products

This is one of the three optional focus areas for Cambridge International A Level candidates in Part 2 of the syllabus. Centres and candidates can choose to study either Product design, Practical technology or Graphic products.

Candidates should learn through practical manipulative experience wherever possible.

Graphic Products	
	<i>Candidates should be able to:</i>
Design influences and methodology	• explain the concepts of market-pull and producer-led design • explain how advances in technology impact upon the evolution of designs • understand and demonstrate the influences of style and fashion upon design • demonstrate an understanding of the need of designers to consider physical, cultural and aesthetic needs • discuss how product designers, designer craftsmen and engineers shape aspects of the man-made environment • show appreciation of the economic implications of design decision making • demonstrate a general understanding of production techniques and marketing methods used in the commercial world • describe and identify current good practice in the use of CAD equipment, recognising the advantages of accuracy, ease of storage/retrieval, ease of modifying drawings, the production of many originals and the integration of data for costing, stock control and production via links with CNC machines • use a range of drawing conventions, including engineering, electrical and architectural
Recording information	• use a range of techniques to record and manipulate information, ideas and processes including free-hand sketching, annotation, bar and pie charts, 2D and 3D charts, graphs, tables, flow charts, pictograms and ideograms • analyse data and other information to explore concepts and ideas
Modelling and testing	• construct two and three dimensional models to explore, test and appraise ideas • use materials, processes and equipment appropriate to the subject to produce refined models to communicate concepts and ideas

Drawing systems	- select and use formal and free-hand drawing techniques appropriate to the subject including: - assembled, exploded and cut-away - orthographic in first and third angle projection - dimensioning - isometric using ellipse templates and approximate constructions for circles and arcs - planometric using 45/45 - perspective using one and two point
Presentation	- demonstrate the ability to enhance the visual impact of an illustration by the use of thick and thin line techniques, tone, colour, shadows, reflections and material representation - demonstrate knowledge of a range of methods for the display and exhibition of information and artefacts, including mounting, break down of space, focal points, circulation of viewers - show understanding of the production and manipulation of images using appropriate reprographic techniques, display stands and representational models
Geometry	- use loci to determine the path of movement of linkages - determine the development (net) of basic geometric forms including prisms, cylinders, pyramids, cones and their frustums - determine the interpenetration of solids including prisms, cylinders, pyramids, cones and their frustums
Mechanisms	- describe methods for transmitting and converting linear and rotary motion including cranks, ratchets and simple cams - construct accurately a cam profile from given data and draw its displacement diagram
Materials	- demonstrate a general knowledge of the characteristics of card, paper and other modelling materials - understand the principles and describe the common forms of processing the above materials including forming, fabricating, shaping, joining and finishing - demonstrate a general knowledge of wood, metals, plastics, concrete, brick, fabrics, glass and ceramics, being able to select them for appropriate use according to their characteristics, properties and performance - be aware of the forms which materials are supplied in and their approximate relative costs

6. Coursework

6.1 Coursework assessment

The coursework projects for Components 2 and 4 are internally marked and externally moderated. See section 6.2 for details of the criteria for assessment. Teachers should use the Coursework Assessment Form to record their marks.

Candidates' marks for components 2 and 4 must be recorded on the Coursework Assessment Summary Form produced by Cambridge. These forms, and instructions for completing them, may be downloaded from **www.cie.org.uk/samples**. The database will ask you for the syllabus code (i.e. 9705) and your Centre number, after which it will take you to the correct forms. Follow the instructions when completing each form.

Depending on the nature of the work produced, the project(s) will be assessed either as two separate components or as a combination of the two components.

Each component should represent approximately 40–50 hours of work. Most of this should be under the direct supervision of a teacher, although because of the nature of some of the work, candidates may do some outside school, e.g. research, testing, etc.

Internal moderation

When more than one teacher in a Centre is giving internal assessments, the Centre must make arrangements for all candidates to be assessed to a common standard.

The internally moderated marks for all candidates must be recorded on the Coursework Assessment Summary Form. This form, and the instructions for completing it, may be downloaded from **www.cie.org.uk/samples**. The database will ask you for the syllabus code (i.e. 9705) and your Centre number, after which it will take you to the correct form. Follow the instructions when completing the form.

External moderation for Centres in Mauritius

The Mauritius Examinations Syndicate will appoint moderators on behalf of Cambridge to carry out external moderation of internal assessment. The Mauritius Examinations Syndicate will send a representative sample to Cambridge once in-country moderation is complete.

External moderation for all other Centres

External moderation of internal assessment is carried out by Cambridge. Centres must submit internally assessed **marks** of **all** candidates to Cambridge. Centres must also submit the internally assessed **work** of a **sample** of candidates to Cambridge. The *Cambridge Administrative Guide*, available on our website, provides details of which candidates are to be included in the sample. The deadlines and methods for submitting internally assessed marks and work are in the *Cambridge Administrative Guide* available on our website.

Centres must enclose the Individual Candidate Record Cards and Coursework Assessment Summary Forms with the coursework sample.

The sample of projects should consist of design folios in paper format no larger than A3 size. Each folio should include sufficient photographs showing an overall view and detailed evidence of the level of achievement reached on the model and/or final product.

Centres must not send 3D models or products to Cambridge for moderation purposes.

The *Cambridge Handbook* and the *Cambridge Administrative Guide* both contain general instructions on the moderation of coursework.

Centres should keep all records and supporting written work until after publication of results.

6.2 Coursework assessment criteria

The weighting of the marks below should give some indication of the approximate amount of time to spend on each part of the project.

For assessment purposes, the criteria below are in a linear form, although some of the work will probably be cyclical in approach and some stages may interrelate.

Component 2:

Criterion	Level of response	Mark range	Maximum mark
1. Identification of a need or opportunity leading to a design brief	Some consideration of the situation or the intended user leading to a design brief.	1	3
	Consideration of both the situation and the intended user leading to a clear design brief.	2	
	Detailed description of both the situation and user leading to a clear and precise design brief.	3	
2. Analysis of and research into the design brief which results in a specification	Intended use of product examined with some data identified or collected. Existing products identified with some evaluation.	1–2	7
	Intended use of product examined with data identified and collected. Existing products identified and evaluated considering some of the needs of the intended user/users. A detailed specification produced.	3–5	
	Intended use of product fully examined with relevant data identified and collected. Existing products identified and fully evaluated against the needs of the intended user/users. Analysis of the research leading to a detailed design specification.	6–7	
3. Generation and appraisal of design ideas	A limited range of ideas proposed. A cursory appraisal of ideas. Unsupported choice of design ideas for development. Several aspects of the specification not considered.	1–5	16
	A range of appropriate ideas proposed. The choice of ideas for development supported by clear appraisal. Most aspects of the specifications highlighted.	6–11	
	A wide range of appropriate ideas proposed. Design proposal chosen as a result of detailed appraisal and consideration of the need and fitness for purpose. All aspects of the specification considered in detail.	12–16	
4. Modelling of ideas	Quality of product marred by limited skills and inappropriate use of materials.	1–4	14
	Competency shown in most aspects of applying skills. Good choice of materials.	5–9	
	Mastery of a wide range of materials. Attention to detail with sound application of materials technology.	10–14	
			Total 40

Component 4:

Criterion	Level of response	Mark range	Maximum mark
5. Product development	As a result of investigations some decisions made about form, materials and production methods. Some reference to the model. Some important details given about the final solution.	1–3	10
	Some testing and trialling resulting in decisions about materials, production methods and other items. Reference to modelling to ensure that the product meets the design brief. Most details given about a final solution and its relevant system of manufacture.	4–7	
	Appropriate testing and trialling resulting in reasoned decisions about form, materials, production methods and other items. Has used the model to identify and make necessary modifications and to ensure the product meets the design brief. Full details about the final solution and the production methods.	8–10	
6. Product planning	Planning will have been restricted to the immediate task and will have relied on prompting. Drawings and information briefly satisfy requirements for making the product.	1	4
	Most of the realisation will have been planned in advance. Drawings and other details provide all information for making the product.	2–3	
	The realisation will have been thoroughly planned to specify an effective order for the sequence of operations. Refined drawings and other detailed information show thorough command of related knowledge.	4	

7. Product realisation	Has overcome problems as they arise using appropriate materials, tools and equipment. With some guidance has used a range of skills and techniques appropriate to the task. Reasonable understanding of safe working procedures. The product will exhibit a reasonable standard of outcome, be mainly complete and will satisfy the specification with a limited degree of success.	1–6	20
	Has made economic and efficient use of materials, tools and equipment modifying the application of these if appropriate. With a normal level of supervision, has combined a range of skills and techniques appropriate to the task. Good understanding of safe working procedures. The product will exhibit a good standard of outcome, will be complete and will function as intended.	7–14	
	Resourceful and adaptable with materials, tools and equipment. Has independently combined a range of skills and techniques appropriate to the task. High understanding of safe working procedures. The product will be completed to a high standard of outcome and will meet the detailed requirements of the design specification.	15–20	
8. Testing and evaluation	Superficial testing with a few conclusions. Some supported comment with reference to the original specification and use of resources.	1–2	6
	Relevant testing with conclusions, leading to possible modification or improvement of product. Relevant comments with reference to initial specification and use of resources.	3–4	
	Detailed testing with meaningful conclusions. Critical evaluation related to initial specification and use of resources. Proposals for further development, modification or improvements of product.	5–6	
			Total 40

7. Other information

Equality and inclusion

Cambridge International Examinations has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. To comply with the UK Equality Act (2010), Cambridge has designed this qualification with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with disabilities or learning difficulties. Arrangements can be put in place for these candidates to enable them to access the assessments and receive recognition of their attainment. Access arrangements will not be agreed if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is found in the *Cambridge Handbook* which can be downloaded from the website **www.cie.org.uk/examsOfficers**

Language

This syllabus and the associated assessment materials are available in English only.

Grading and reporting

Cambridge International A Level results are shown by one of the grades A*, A, B, C, D or E, indicating the standard achieved, A* being the highest and E the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade E. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

Cambridge International AS Level results are shown by one of the grades a, b, c, d or e, indicating the standard achieved, 'a' being the highest and 'e' the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for grade 'e'. 'Ungraded' will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results) and Y (to be issued) may also appear on the statement of results but not on the certificate.

If a candidate takes a Cambridge International A Level and fails to achieve grade E or higher, a Cambridge International AS Level grade will be awarded if both of the following apply:

- the components taken for the Cambridge International A Level by the candidate in that series included all the components making up a Cambridge International AS Level
- the candidate's performance on these components was sufficient to merit the award of a Cambridge International AS Level grade.

For languages other than English, Cambridge also reports separate speaking endorsement grades (Distinction, Merit and Pass), for candidates who satisfy the conditions stated in the syllabus.

Entry codes

To maintain the security of our examinations, we produce question papers for different areas of the world, known as 'administrative zones'. Where the component entry code has two digits, the first digit is the component number given in the syllabus. The second digit is the location code, specific to an administrative zone. Information about entry codes for your administrative zone can be found in the *Cambridge Guide to Making Entries*.

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