Syllabus

Cambridge IGCSE Design and Technology
Syllabus code 0445
For examination in June and November 2013

UNIVERSITY of CAMBRIDGE
International Examinations

Contents

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1. Introduction

1.1 Why choose Cambridge?

University of Cambridge International Examinations (CIE) is the world's largest provider of international qualifications. Around 1.5 million students from 150 countries enter Cambridge examinations every year. What makes educators around the world choose Cambridge?

Recognition

Cambridge IGCSE is internationally recognised by schools, universities and employers as equivalent to UK GCSE. Cambridge IGCSE is excellent preparation for A/AS Level, the Advanced International Certificate of Education (AICE), US Advanced Placement Programme and the International Baccalaureate (IB) Diploma. Learn more at **www.cie.org.uk/recognition**.

Support

CIE provides a world-class support service for teachers and exams officers. We offer a wide range of teacher materials to Centres, plus teacher training (online and face-to-face) and student support materials. Exams officers can trust in reliable, efficient administration of exams entry and excellent, personal support from CIE Customer Services. Learn more at **www.cie.org.uk/teachers**.

Excellence in education

Cambridge qualifications develop successful students. They build not only understanding and knowledge required for progression, but also learning and thinking skills that help students become independent learners and equip them for life.

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

CIE is part of Cambridge Assessment, a not-for-profit organisation and part of the University of Cambridge. The needs of teachers and learners are at the core of what we do. CIE invests constantly in improving its qualifications and services. We draw upon education research in developing our qualifications.

1. Introduction

1.2 Why choose Cambridge IGCSE Design and Technology?

The Cambridge IGCSE Design and Technology syllabus enables candidates to identify, consider and solve problems through creative thinking, planning and design, and by working with different media, materials and tools.

Candidates gain technical and design awareness as a result, and develop skills such as initiative, resourcefulness, enquiry and ingenuity. They also develop the communication skills central to design making and evaluation.

Cambridge IGCSE Design and Technology provides an ideal basis for further study, and prepares students for their future within a rapidly changing technological society.

1.3 Cambridge International Certificate of Education (ICE)

Cambridge ICE is the group award of the International General Certificate of Secondary Education (IGCSE). It requires the study of subjects drawn from the five different IGCSE subject groups. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognising the achievements of students who pass examinations in at least seven subjects, including two languages, and one subject from each of the other subject groups.

The Cambridge portfolio of IGCSE qualifications provides a solid foundation for higher level courses such as GCE A and AS Levels and the International Baccalaureate Diploma as well as excellent preparation for employment.

A wide range of IGCSE subjects is available and these are grouped into five curriculum areas. Design and Technology (0445) falls into Group V, Creative Technical and Vocational Subjects.

Learn more about ICE at **www.cie.org.uk/qualifications/academic/middlesec/ice**.

1.4 How can I find out more?

If you are already a Cambridge Centre

You can make entries for this qualification through your usual channels, e.g. CIE Direct. If you have any queries, please contact us at **international@cie.org.uk**.

If you are not a Cambridge Centre

You can find out how your organisation can become a Cambridge Centre. Email us at **international@cie.org.uk**. Learn more about the benefits of becoming a Cambridge Centre at **www.cie.org.uk.**

2. Assessment at a glance

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Candidates must take Paper 1, one of Papers 2–4 and Paper 5, which is a Project. When Centres enter candidates they must indicate which optional paper (Papers 2–4) each candidate is going to take.

Candidates take Paper 1 and the optional Paper 2, 3 or 4 together, in one session of 2 hours and 15 minutes.

Candidates will receive grades from A* to G.

Candidates take:		
Paper 1	Design	1 hour 15 minutes
This is a compulsory paper. It tests design drawing, and 50 marks are available.		
25% of total marks		

and one of:		
Paper 2 Graphic products 1 hour	**Paper 3** Resistant materials 1 hour	**Paper 4** Systems and control 1 hour
This is an optional graphics paper. 50 marks are available.	This is an optional written paper. 50 marks are available.	This is an optional written paper. 50 marks are available.
25% of total marks	25% of total marks	25% of total marks

and:		
Paper 5	Project	2 terms
The Project is compulsory and is a school-based assessment. 100 marks are available for the project.		
50% of total marks		

2. Assessment at a glance

Availability

This syllabus is examined in the May/June examination session and the October/November examination session.

This syllabus is not available to private candidates.

Centres in the UK that receive government funding are advised to consult the CIE 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 session with any other CIE syllabus, except:

- syllabuses with the same title at the same level
- 7048 O Level CDT: Design and Communication

Please note that IGCSE, Cambridge International Level 1/Level 2 Certificates and O Level syllabuses are at the same level.

3. Syllabus aims and objectives

3.1 Aims

The aims of the Cambridge IGCSE Design and Technology syllabus are to enable candidates to develop:

- awareness, understanding and expertise in those areas of creative thinking which can be expressed and developed through investigation and research, planning, designing, making and evaluating, working with media, materials and tools
- the ability to solve practical and technological problems using processes of analysis, synthesis and realisation
- a range of communication skills which are central to design, making and evaluation
- a range of making skills
- the desire to relate their work to their personal interests and abilities by learning and experimenting with materials in practical areas
- greater curiosity, enquiry, initiative, ingenuity, resourcefulness and discrimination
- improved technological awareness, attitudes of co-operation and social responsibility and abilities to enhance the quality of the environment
- the ability to make value judgements of an aesthetic, technical, economic and moral nature

3.2 Scheme of assessment

All components of the assessment scheme (Papers 1–5) test the content of Part 1 of the syllabus. Candidates need to demonstrate their knowledge of the Part 2 option they have chosen in Paper 1, as well as in the optional paper and the project. 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.

Paper 1: Design

This compulsory question paper tests Part 1 of the syllabus. Candidates answer one of three open-ended questions which assess their abilities of analysis and synthesis. The range of questions will reflect the breadth of optional content.

Papers 2–4: Options

Candidates take **one** of the three optional papers (Papers 2, 3 and 4). Each of these papers has a Section A and a Section B. Section A consists of compulsory questions which test knowledge of the optional subject. Section B consists of longer structured questions: in Paper 2 candidates choose one out of two questions; in Papers 3 and 4 candidates choose one out of three questions.

Paper 5: Project

Each candidate must complete an individual project which centres on the option they have chosen from Part 2 of the syllabus. Candidates usually work on their project over the final two terms of the course. The project is internally marked and externally moderated.

Although each candidate bases their project on the option they have chosen, the nature of Design and Technology means that each candidate's work is likely to cover content from other options as well. Typically, candidates produce work in the form of an A3-size folder and the 'made product'. If candidates have chosen the Graphic Products option their folder could contain all the preliminary design work, and their 'made product' could be in the form of 2 dimension work and models.

The folder must include sufficient photographs of the made product, showing an overall view together with detailed views of evidence which support the award of marks for assessment criterion 6 'Product realisation'. (See Project assessment criteria in section 5.1.)

Teachers must get written approval from CIE before they enter candidates and begin school-based assessment. Approval will be given to teachers based on prior experience and/or whether they have undertaken special training in assessment and satisfy CIE requirements concerning moderation. CIE offers schools in-service training using the *Coursework Training Handbook* available from CIE Publications.

CIE will select which candidates will have their work externally moderated. The Handbook for Centres and Administration Guide contain further information.

3.3 Assessment objectives and their weighting in the exam papers

There are four assessment objectives in Cambridge IGCSE Design and Technology:

A Knowledge with understanding

Candidates should be able to:

- demonstrate the ability to state facts, recall and name items, recall and describe processes
- demonstrate the ability to apply and relate knowledge to designing and making
- make reasoned arguments and anticipate consequences about the outcomes of the Design and Technology process
- demonstrate a crucial awareness of the interrelationship between Design and the needs of society

B Problem solving

Candidates should be able to:

- recognise problems, clearly identify from the problem situation a specific need which requires a solution and compose a design brief
- analyse a problem by considering any relevant functional, aesthetic, human, economic and environmental design factors and draw up a design specification
- investigate, research, collect and record relevant data and information
- generate a range of outline solutions to a design problem, giving consideration to the constraints of time, cost, skill and resources
- develop, refine, test and evaluate the effectiveness of design solutions

C Communication

Candidates should be able to:

- recognise information in one form and where necessary change it into a more applicable form
- produce or interpret data in a variety of forms such as charts, diagrams, graphs and flow charts
- propose and communicate ideas graphically using a range of media
- develop ideas and represent details of form, shape, construction, movement, size and structure through graphical representation and three dimensional modelling

D Realisation

Candidates should be able to:

- plan and organise the work procedures for the realisation of a solution
- select, from a range, the appropriate resources for the realisation of the product
- demonstrate appropriate manipulative skills by showing an understanding of materials and their characteristics in relation to their use
- evaluate the process and product in terms of aesthetic, functional and technical quality

3. Syllabus aims and objectives

The weighting of the assessment objectives indicates their relative importance. It does not indicate exactly how many marks are available for each assessment objective in each paper.

Assessment objective	Paper 1	Paper 2, 3 or 4	Project	Overall
Knowledge with understanding	4%	15%	–	19%
Problem solving	10%	3%	30%	43%
Communication	6%	3%	–	9%
Realisation	5%	4%	20%	29%
Total	25%	25%	50%	100%

4. Curriculum content

4.1 Part 1: Design

The curriculum objectives in Part 1 are compulsory. Paper 1 (Design) and Paper 5 (Project) specifically assess these objectives. Teachers should also integrate this core content when teaching the optional specialist area from Part 2.

Centres and candidates are encouraged to use CAD/CAM throughout the curriculum if they have the facilities. However, the examination does not test candidates on CAD/CAM.

Part 1: Design	
Objective:	*Candidates should be able to:*
Observe need/requirement	• identify and describe needs and opportunities for design and technological improvement
Design brief/specification	• analyse and produce design specifications for problems which they, or others, have identified
Identification/research	• identify the constraints imposed by knowledge, resource availability and/or external sources which influenced proposed solutions • gather, order and assess information relevant to the solution of practical/technological problems • produce and/or interpret data (e.g. diagrams, flow charts, graphs, experimental and test results)
Generation of possible ideas	• generate and record ideas as potential solutions to problems using a range of techniques • identify what resources they need for solving practical/ technological problems • use a variety of media and equipment to produce models and mock-ups as a means of exploring a problem and as a means of testing the feasibility of a solution • recognise the need for continuous appraisal of their own progress, thinking and decision making, in order to provide themselves with opportunities for review • relate these judgements to the purpose of their study, in particular the specification which they set themselves
Selection/organisation	• select and develop a solution after consideration of time, cost, skill and resources • organise and plan in detail the production of the selected solution

4. Curriculum content

Evaluation	• evaluate existing products/systems, the work of others and their own work • check the performance of the product/solution against the original specification • use different methods and sources to assess the effectiveness of a product (e.g. sampling, questionnaires, interviews) • suggest any possible modification and improvements (consideration to include functional, safety, aesthetic, ergonomic and economic factors)
Implementation and realisation	• show an awareness of correct procedures for their preparation • show an awareness of the correct and accurate methods of drawing, marking out and testing • select appropriate processes for shaping, forming, cutting, joining, fitting, assembling and finishing a variety of materials
Health and safety	• show an awareness of the correct use of hand and machine tools and equipment • show a proper regard for all mandatory and other necessary safety precautions relevant to the use of a variety of tools, machines, materials and other resources • show a concern for economy in the use of materials, components, media, time, energy and other resources
Initiation and development of ideas, and recording of data	• extract relevant information from sources (written, graphical, oral, computer based); interpret and record information and data
Communicating ideas with others	• use technical vocabulary, number skills, colour, shading and other media to produce sketches, models, diagrams, drawings (such as perspective, isometric, orthographic, sequential) and written materials, which communicate their ideas with precision and clarity
Design and Technology in society	• show awareness of the effect of design and technology activity on social, environmental and economic issues • demonstrate awareness of the role of designers, craftsmen and technologists in industry and society • take a range of human needs into account, including aesthetic, ergonomic, economic, environmental, cultural and social
Aesthetics	• appreciate the use of line, shape, form, proportion, space, colour and texture as appropriate to their designed solutions and the work of others

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Anthropometrics and ergonomics	• demonstrate an understanding of the concept of ergonomics and the use of anthropometric data in their own design work and that of others
Energy	• recognise that different forms of energy sources exist, namely, fossil fuels, nuclear, renewable • understand how it is possible to store, convert and transmit different sources and forms of energy in order to produce a work capability and to improve the quality of life • understand the inefficiencies of energy conversion methods, e.g. 'losses' into by-products such as heat, light and sound • understand the difference between the finite and almost finite nature of energy sources and how design can help to conserve all energy sources • use energy sources effectively and efficiently
Control	• identify the features of a control system in terms of input devices, processing elements, output devices, feedback
Mechanical control (static)	• understand the use of common fastenings and fittings applicable to the holding of metal, wood, plastics, card and paper
Permanent fastenings	• choose sensibly between common and appropriate methods applicable to most common materials; this should include simple joining, the use of adhesives, riveting and welding
Mechanical control (dynamic)	• understand methods of transmitting motion using simple systems only; examples should include belts, chains, pulleys, gears and cams

Part 2: Graphic products

This is an optional part of the syllabus. Centres and candidates can choose to study either Graphic products, Resistant materials or Systems and control.

It is a good idea to teach the following objectives in a practical way, wherever possible, and to integrate them with the content of Part 1.

This area of study aims to develop the skills that designers use within the context of their design activities in the design studio. It also aims to develop an awareness of the importance of communication and modelling techniques concerned with promotion and illustration of ideas and their interrelationship with all stages in commercial manufacture and promotion. Teachers should refer to the role that graphic products have in one or more of the following or similar areas:

- Packaging
- Promotional design
- Display
- Product design
- Manuals
- Transport
- Architectural modelling
- Corporate identity
- Interior design

Part 2: Graphic products	
Objective:	*Candidates should be able to:*
Formal drawing	• demonstrate a working knowledge of appropriate British Standards, including the dimensioning of drawings and drawing to recommended scales
Orthographic projection	• identify and use both first and third angle orthographic projection (examination questions will include both first and third angle orthographic projection)
Isometric	• understand and use this form of drawing, including isometric views of circles, arcs and other curves (isometric scale is not required)
Planometric	• understand and use this form of drawing at 45° × 45° and 60° × 30°, including circles and arcs (scaling is not required)
Estimated two-point perspective	• understand and use this form of drawing using one-point and two-point starts and using perspective grids
Sectional views	• select the most suitable section and draw whole, part, revolved and removed sections
Exploded views	• draw exploded views of component parts along one axis only

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Assembly drawings	• assemble given component parts into a single drawing, including parts lists
Freehand drawing	• use freehand drawing to communicate ideas, thoughts and information from written, visual and tabular data, presenting these ideas in pictorial, plane or orthographic mode
The use of appropriate and relevant geometrical constructions to determine basic shapes	• construct regular and irregular plane linear shapes, including triangles, quadrilaterals, pentagons, hexagons and octagons, and bisect, sub-divide and proportionally divide lines; construct circles, tangents and tangential arcs
Developments	• construct developments of cubes, prisms, cylinders and cones, including simple truncations
Ellipses	• construct ellipses by any accurate method, including the use of a trammel
Use of instruments	• use instruments to achieve a good standard of graphical representation
Use of drafting aids	• use drawing aids including technical pens, templates, lettering and other stencils, radius aids, flexicurves (candidates can use ellipse aids and nut templates in the examination, unless it states otherwise)
Layout and planning	• select the most suitable layout to achieve visual impact and to convey information clearly and effectively
Presentation	• demonstrate the following range of techniques: – thin and thick line – light and shade to show form and mass – textural representations to illustrate a range of materials – colour rendering using a range of materials and aids • emphasise their ability to select the most relevant method to present information for a particular purpose • use clarity and good proportion to demonstrate the different modes of drawing diagrams and lettering necessary for the communication of information according to content, purpose and user • demonstrate an awareness of an ability to produce varied lettering effects by the use of: – different lettering styles – different letter spacing – dry transfer methods – stencils – computer-generated lettering

4. Curriculum content

Data graphics	• produce Line, Pie, Bar and Flow charts/graphs from data provided • produce sequence drawings from data provided • show an understanding of the range and purpose of standardised signs and symbols
Reprographics	• have a knowledge of commercial printing methods such as gravure, lithography
Modelling	• understand the purposes of modelling; have a knowledge of the following materials: paper, card, modelling materials, Styrofoam, foam board, plastics

4.3 Part 2: Resistant materials

This is an optional part of the syllabus. Centres and candidates can choose to study either Graphic products, Resistant materials or Systems and control.

It is a good idea to teach the following objectives in a practical way, wherever possible, and to integrate them with the content of Part 1.

This area of study aims to develop the skills which designers use within the context of materials and their processing. Candidates need practical experience so that they can get a broad understanding of materials and their processing rather than an in-depth knowledge of any particular material, technology or process. This practical experience should include:

- the general physical and working properties of common construction materials (plastics, woods and metals) in relation to specific designing and making tasks
- simple comparative testing leading to the reasoned selection of materials and processes for specific design and making tasks

Part 2: Resistant materials	
Objective:	*Candidates should be able to:*
Practical applications	• design and make practical products using the concepts, knowledge and skills listed in this syllabus
Types of material	• understand the physical and working properties and application in relation to plastics, woods and metals
Plastics	• show a working knowledge of the following: – thermoplastics (nylon, polythene, polyvinyl chloride (PVC), acrylic, polystyrene, polypropylene) – thermosetting plastics (polyester resin including GRP, melamine, urea formaldehyde and phenol formaldehyde)
Woods	• show a working knowledge of natural timbers and understand their classification, properties and uses • understand why timber is seasoned and how to care for timber during storage and construction • show a working knowledge of the following manufactured boards: plywood, blockboard, chipboard, hardboard and MDF
Metals	• show a working knowledge of the following metals: – ferrous metals (mild and high carbon steels) – non-ferrous metals (aluminium, duralumin and other common casting alloys, copper and its alloys, zinc, lead and tin)

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Preparation of materials	• show knowledge of available market forms, types and sizes • understand methods of cutting by use of hacksaw, guillotine, tenon saw, cross-cut saw, panel saw and portable power tools • understand the use of datum surfaces/lines/edges and be able to produce them by planing or filing • explain the preparation for machine processes and safe methods of securing materials to work surfaces, work tables, faceplates, lathe chucks and between centres on a lathe
Setting/marking out	• measure and/or mark out work using ruler, pencil, marker pen, scriber, try square, bevel, dot/centre punch, dividers, marking gauge, cutting gauge and mortise gauge • accurately produce datum lines by surface plate and scribing block or callipers • accurately measure using a micrometer and a vernier gauge
Shaping	(a) Deforming/reforming • understand the following processes: bending, simple casting, lamination; vacuum forming; blow moulding; injection moulding; extrusion (b) Wastage/addition • select and perform the following forms of cutting and removal of material, and joining and adding to a material to produce the required shape, form or contour: – use hand snips, saws, files, basic planes and abrasive cutters – simple hole boring by hand or machine including pilot, clearance, tapping, countersunk and counterbored holes – use taps and dies for screw cutting by hand – use planes, chisels, gouges, saws, files and rasps – use abrasive mops, discs and belts
Special treatments	• understand how the following processes can change the molecular structure of a material making it more or less suitable for the task it has to perform: – work hardening – annealing all metals – case hardening of mild steel – hardening and tempering tool steel (HCS) • understand the term plastic memory and its significance • understand steaming and bending of timbers and have knowledge of adhesives' curing times and strengths

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Joining and assembly	• use various methods of fabrication and fitting to join parts of a desired structure. Allow any required movement, to enable it to perform its task satisfactorily (permanently or temporarily) • understand methods of carcase, stool and frame construction using permanent and temporary joints • use holding devices, formers and jigs to assist joining and assembly • understand the use of KD (knock-down) fittings for use with modern materials such as veneered chipboard • use a variety of fittings and adhesives
Finishing	• understand the preparation for and application of surface treatments • be aware of a range of different finishes including oils, paints, lacquers, stains, satin polishes, dipcoating • be aware of surface finishes available for both interior and exterior use • be aware of the special finishes available that will prevent corrosion or stains, or withstand heat or liquids

4.4 Part 2: Systems and control

This is an optional part of the syllabus. Centres and candidates can choose to study either Graphic products, Resistant materials or Systems and control.

It is a good idea to teach the following objectives in a practical way, wherever possible, and to integrate them with the content of Part 1.

This area of study aims to develop the skills and knowledge used by designers within the context of a group of related technological resource areas: structures, mechanisms and electronics. Candidates need practical experience so that they can get a broad understanding of the three resource areas. By identifying how these areas interrelate, candidates can appreciate and exploit their role in designing and making controlled systems.

Part 2: Systems and control – Structures	
Objective:	*Candidates should be able to:*
Designing and making	• design and make working models and practical products applying the concepts, knowledge and skills listed, and using resistant materials, components and kits • design, make and evaluate a static structure • use the principle of levers to design and make a simple machine that is structurally sound • use electric motors and solenoids to power simple mechanical models, and both bread-boarded and pcb-built electronic circuits to control them
Testing	• use a simple dial gauge to measure the deflection of simple structures • understand the use of strain gauges for testing, common structural and mechanical members/components under strain
Moments (turning forces)	• define a moment as force × distance (Nm) • demonstrate an understanding of the use of moments in simple calculations relating to the loading of beams and levers
Structure and forces	• calculate and analyse simple forces using triangle and parallelogram representation; examples will include support wires, tripods, shear legs and frames • understand the design and construction of structures which withstand stress and take stationary and moving loads
Types of structure	• identify and classify both natural and man-made structures as they occur in everyday life

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Types of structural member	• draw, describe and identify various types of member such as beam, strut and tie
Materials	• describe, compare and contrast the properties of the following structural materials when used in the construction of beams, frames, arches and cables: – woods, metals, stone, concrete, plastics and composites
Nature of structural members	• understand how length, shape of cross-section and material selection affects performance
Joints in structures	• apply sound judgement when selecting the appropriate method of joining materials of solid and hollow cross section • select and use different methods of reinforcing such as gussets, ribs, braces and laminating
Framed structures	• recognise frames in use and identify the use of triangulation to establish rigidity
Applied loads and reactions	• apply the concept of equilibrium as a result of applied load and reaction • understand what is meant by the following terms and their relationship to structural design: tension, compression, shear, bending, torsion and static load (simple examples only)
Forces	• understand Hooke's Law and the relationship between extension and load • understand Stress = $\frac{\text{force}}{\text{cross sectional area}}$ • understand Strain = $\frac{\text{change in length}}{\text{original length}}$ • understand Young's Modulus of Elasticity as: $\frac{\text{Stress}}{\text{Strain}}$ (N/mm^2) • draw and interpret a typical stress/strain graph for mild steel and identify the important features on this graph • understand the significance of these features to structural design • understand the term Factor of Safety and its importance to structural design

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Part 2: Systems and control – Mechanisms	
Objective:	*Candidates should be able to:*
General concepts	• explain and use the following terms correctly: load, effort, fulcrum, mechanical advantage, velocity ratio and efficiency
Levers	• identify and sketch simple examples of first, second and third order levers, and associated linkages
Transmission of motion	• select appropriately and list the factors influencing the choice of the following for practical applications: – gears: ◦ spur, bevel, worm, rack and pinion – belts and pulleys: ◦ flat, toothed, round and vee belts and pulleys ◦ sprockets and chains ◦ standard systems to maintain tension in drive belts and chains • calculate simple gear ratios and transmission speed • determine the Mechanical Advantage (MA), Velocity Ratio (VR), efficiency and rotational direction for the following: – wheel and axle, screw jack, compound pulley and gear arrangements
Energy	• describe the power sources used to drive mechanical systems and recognise a battery as an electrical energy storage/conversion device • understand the energy costs of powering systems and how it is possible to reduce the potential energy demand through good design and manufacture
Bearings and lubrication	• recognise the need to reduce friction between two surfaces by design, and describe the types of lubrication, and other methods of application for different situations • compare and contrast the use of plain, roller and ball bearings, and give reasons for their suitability for specific operational conditions
Conversion of motion	• recognise and give examples of the following types of motion: rotary, linear, reciprocating and oscillating • understand the terms crank, cam, follower, dwell, stroke, screw thread, pitch • compare and select appropriately crankshafts, crank/slider mechanisms, rack and pinion, ratchet and pawl, eccentrics, simple cams and screw threads as methods of converting motion from one type to another

4. Curriculum content

Part 2: Systems and control – Electronics	
	Candidates should be able to:
Basic concepts	• use correct symbols and conventions when drawing circuit diagrams • describe the operation of a circuit in terms of conventional current flow • identify and compare conductivity and insulation when selecting materials • understand and apply units used to measure current, voltage, resistance and capacitance, including multiple and sub-multiple units • understand the relationship between current, voltage and resistance (Ohm's Law) and use to calculate the value of a current limiting resistor • use ammeters, voltmeters and multimeters to measure current, voltage and resistance • perform simple power calculations using P = VI
Switches	• understand the action and application of the following common switches: – toggle, push button (PTM/PTB), micro, rotary and reed • understand the terms normally closed (NC), normally open (NO), single pole single throw (SPST) and double pole double throw (DPDT) in relation to switches and relays • use relays to switch higher voltage circuits for motors, solenoids, etc. • construct and draw circuits which use a two pole change-over relay to give motor reverse control and latched (memorised) switching
Resistors	• make use of the resistor colour code to determine the value and tolerance of a resistor and to select the nearest suitable value • draw circuit diagrams and perform calculations for resistors in series and parallel • understand the term potential divider and perform calculations to determine values of resistance and voltage in potential divider circuits
Transistors	• describe the operation of transistors in terms of the base bias voltage controlling the collector emitter circuit • select appropriately the use of NPN transistors as switches in circuits
Diodes	• understand the use of a diode as a one way conductor, and its use in a relay circuit to protect against back emf • use LEDs in circuits and be able to calculate the value of a suitable current limiting resistor to protect LEDs

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Transducers	• understand the use of the following transducers: • LDR, thermistor, strain gauge
Capacitors	• explain the charging and discharging of a capacitor, with the aid of diagrams/ graphs
Time delay circuits	• construct and draw circuit diagrams for time delay circuits (monostable and astable) using capacitors, resistors, transistors and the 555 timer IC • use $T = C \times R$ to calculate simple time delays • use graphs and data to be able to select components to achieve a desired time delay
Logic gates	• understand the use of logic gates (AND, OR, NAND, NOR, NOT) and truth tables for simple logic control systems • give examples of the use of logic control systems in everyday life, e.g. heating control, traffic lights, environmental control in a greenhouse, etc.

5. Project assessment

5.1 Project assessment criteria

Criterion	Level of response	Mark range	Maximum mark
1. Identification of a need or opportunity with a brief analysis leading to a design brief	A statement of what is to be made.	1	5
	Consideration of the design need or the intended user(s) leading to a design brief.	2–3	
	Consideration of both the design need and the intended user(s) leading to a clear design brief.	4–5	
2. Research into the design brief resulting in a specification	Limited examination of the design brief with a specification identifying some basic requirements.	1–3	10
	Meaningful research of the design brief with some data identified. A specification including key features of the intended product.	4–7	
	Thorough research of the design brief with relevant data identified and collected. Analysis of the research leading to a detailed specification for the intended product.	8–10	
3. Generation and exploration of design ideas	A limited range of ideas with a tendency to focus on a single concept. Little or no evaluation of ideas.	1–7	20
	A range of appropriate solutions proposed. Ideas examined with evaluations leading to the identification of possible ideas for development.	8–13	
	A wide range of appropriate solutions with imaginative interpretation. Detailed evaluation of ideas and consideration of the requirements of the specification.	14–20	
4. Development of proposed solution	Some decisions made about form, materials and/or construction methods.	1–5	15
	As a result of investigation, appropriate decisions made about form, materials and construction/production methods. Evidence of some testing and/or trialling.	6–10	
	Appropriate testing and trialling resulting in reasoned decisions about form, materials, construction/production methods and other items.	11–15	

5. Project assessment

Criterion	Level of response	Mark range	Maximum mark
5. Planning for production	Limited evidence of any forethought. A working drawing with little detail.	1–3	10
	A simple plan showing awareness of the main processes involved. A clear working drawing showing overall layout and major dimensions.	4–6	
	Clear and detailed planning showing an effective order for the sequence of operations. Drawings and other information give full details of the final product.	7–10	
6. Product realisation	The product will exhibit a reasonable standard of outcome, be mainly complete and satisfy some aspects of the specification.	1–10	30
	The product may have some minor inaccuracies and blemishes but will be complete and function as intended.	11–20	
	The product will be completed to a high standard of outcome with precision and accuracy. It will meet fully the requirements of the product specification.	21–30	
7. Testing and evaluation	Little or no evidence of testing. General overall appraisal with little reference to the specification.	1–3	10
	Appropriate reporting and/or comment on simple testing. Reference to the specification with some conclusions leading to possible modifications or improvements.	4–6	
	Objective testing with reference to the specification and user. Detailed and meaningful conclusions leading to proposals for further development.	7–10	

5.2 Moderation

Internal moderation

When several teachers in a Centre are making internal assessments, the Centre must make arrangements for all candidates to be assessed to a common standard.

The Centre must moderate the marks for each skill assigned within different teaching groups (e.g. different classes). The Centre assessments will then be moderated externally.

External moderation

CIE carries out external moderation of internal assessment.

Centres must send the internally moderated marks for all candidates to CIE; the marks must arrive by 30 April for the May/June examination and by 31 October for the November examination. Centres can submit marks either by using MS1 mark sheets or by using Cameo (see the Handbook for Centres).

After receiving the marks, CIE will select a sample of candidates for external moderation. CIE will send the list of selected candidates to the Centre, and the Centre should despatch the coursework of these candidates to CIE immediately. Centres must enclose the Individual Candidate Record Cards and Coursework Assessment Summary Forms (see Appendix) with the coursework.

The Handbook for Centres and the Administrative Guide for Centres both contain further information about external moderation.

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

Centres must not send made products to CIE for moderation. However, folders must include sufficient photographs of the made product showing an overall view as well as detailed views of evidence to support the award of marks for assessment criterion 6 'Product realisation'.

6. Appendix

6.1 Grade descriptions

A **Grade A** candidate must show mastery of the core curriculum and an outstanding performance on the more design-orientated problems.

A **Grade C** candidate must show mastery plus the ability to answer questions which are pitched at a more design-orientated level.

A **Grade F** candidate must show success in a majority of tasks set on the core curriculum.

The aim of these grade descriptions is to give a general indication of the standards of achievement that candidates who receive Grades A, C and F are likely to have shown or achieved.

A Knowledge with understanding

	Grade F	**Grade C**	**Grade A**
Recall knowledge	Name, where shown, some of the items outlined in the syllabus and recall knowledge about them.	Identify and describe with accuracy and understanding a wide range of items which the syllabus outlines.	Identify and describe accurately most of the syllabus content presented in a variety of contexts.
Identify, apply and relate procedures	name and recall, when shown, some of the procedures, including safety, which the syllabus outlines.	Identify, describe with some detail and relevance and apply a wider range of procedures, including evidence of safe practice, which the syllabus outlines.	Determine, describe fully and apply in an organised and safe manner procedures which the syllabus outlines.
Provide explanations	Make elementary statements about some aspects of knowledge which the syllabus outlines.	Make detailed explanation, generally substantiated, of aspects covering a range of the syllabus.	Provide a structured and detailed explanation for the majority of items in the syllabus content.
Reason and predict consequences	Produce statements based on experience.	Predict consequences with some accuracy, giving reasons, based on evidence available.	Predict consequences across a variety of situations, using sound reasoned arguments in a variety of situations.
Showing understanding of Design and Technology (DT) concepts and principles	Recognise similarities between related aspects of DT.	Provide simple explanations reflecting an understanding of basic DT concepts and principles.	Recognise, explain and apply DT concepts and principles across a variety of situations.

6. Appendix

B Design problem solving

	Grade F	**Grade C**	**Grade A**
Recall problems	Interpret a given brief in a simple manner; recognise rudimentary aspects of a situation.	Examine a familiar situation. Identify some real needs, compose a brief and draw up a specification.	Assess a familiar situation and recognise its principal needs; compose a design brief and specification, with some understanding of precision and prescription.
Analyse problems	Engage in one of the following typical procedures: • gather some relevant information from readily available sources • explore a category of user need • consider aspects of use in a particular location • investigate a range of resource options • consider straightforward aspects of the problem.	Gather relevant information and apply it meaningfully to the active exploration of factors such as: • a variety of user needs • the influences different environments have • the effect of resources and processes • products with similar or related functions.	Systematically seek to identify and evaluate information and factors in a design situation concerning: • user needs, ergonomic and functional modes of use • environments, locations and changes within each • the availability and effect of materials and manufacturing processes • the factors in the identity of a product: appearance, efficiency, compatibility.
Envisage solutions	Envisage one type or form of solution.	Generate alternative forms of solution and propose some variation within one form.	Produce ideas for solutions which are varied in form and detail and occasionally innovative. Apply sound judgements regarding feasibility and appreciate implications for brief, specification and production.

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	Grade F	Grade C	Grade A
Refine and develop a solution	Suggest modifications to a proposal and be aware of cost as a factor.	Show progression in developing a proposal or idea. Consider modifications in relation to appearance, cost efficiency and feasibility.	Systematically develop and modify proposals or ideas in relation to appearance, cost, efficiency and feasibility, taking into account the manufacturing process.
Evaluate and test a solution	Make simple statements about the end product.	Evaluate the end product in terms of the brief with respect to function, appearance, cost and overall performance.	Accept evaluation as a feature of all design stages; show detachment in making judgements and seeking evaluation techniques. Offer sensible modifications for improving a feature.

C Design communication

	Grade F	Grade C	Grade A
Recognise and transform	Recognise and change elementary forms of spoken, tactile, visual and written information which are related to everyday examples expressed in concrete and real ways.	Seek readily available and clearly defined information and transfer this information efficiently into other suitable forms.	Seek, recognise and transform information in an effective and economical manner across a variety of applicable forms.
Select means of communication	Select from a previously experienced elementary range of communication methods, those the candidate considers to be appropriate for the transmission of ideas and information.	Select communication methods which will clearly transmit ideas and information.	Select and discriminate between those communication methods which are the most appropriate and effective for transmitting ideas and information.

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	Grade F	Grade C	Grade A
Convey information	Convey elementary information with some clarity using simple technical vocabulary.	Convey information clearly using an appropriate technical vocabulary.	Convey information appropriately, precisely and concisely.
Convey ideas	Convey ideas in an elementary form.	Convey ideas with clarity in a structured and appropriate manner.	Convey a sequence of ideas in a fluent manner by the most appropriate means.
Represent detail	Represent form by a recognisable outline.	Represent details of a form with some accuracy and precision and using a range of conventions.	Represent detail of a form with clarity and precision, taking full account of appropriate conventions.

D Design realisation

	Grade F	Grade C	Grade A
Plan for realisation	Respond to planning suggestions in an order influenced by experience and personal transformation skills.	Plan for realisation in related stages pursued in a sequence leading to sensible completion when viewed against the designed solution.	Plan for realisation in related stages, pursued in a logical sequence leading to full completion when viewed against the designed solution.
Select resources	Select from a previously experienced range of resources which the candidate considers to be appropriate.	Select from the range of resources which the candidate judges to be the most appropriate after consideration of suitability, availability and cost.	Select from the range of resources which the candidate judges to be the most appropriate after researching characteristics, investigating suitability and checking availability and cost.

6. Appendix

	Grade F	**Grade C**	**Grade A**
Select tools and processes	Select from a range of previously experienced tools, instruments and processes those which the candidate identifies as adequate to achieve the intended realisation.	Select from an immediately available range of tools, instruments and processes those which are appropriate to achieve realisation.	Select from the range of tools, instruments and processes available those which are appropriate and effective to achieve an efficient realisation.
Demonstrate transformation skills	Apply rudimentary manipulative or graphic skills, resulting in a realisation which meets some aspects of the designed solution.	Apply manipulative or graphic skills accurately enough to make a product which meets a significant proportion of the designed solution.	Apply manipulative or graphic skills with sufficient precision to make a product which closely reproduces the detail given in the designed solution.
Evaluate process and produce quality	Make simple statements demonstrating awareness of some of the aesthetic, functional and technical characteristics of the product.	Make statements demonstrating an appreciation of any strengths and weaknesses of some of the aesthetic, functional and technical characteristics of the product, making simple modifications where required.	Make detailed statements demonstrating an insight and awareness of and response to weaknesses of the aesthetic, functional and technical characteristics of the product, proposing appropriate modifications where required.

6. Appendix

A. INSTRUCTIONS FOR COMPLETING COURSEWORK ASSESSMENT SUMMARY FORMS

1. Complete the information at the head of the form.
2. List the candidates in an order which will allow ease of transfer of information to a computer-printed Coursework mark sheet MS1 at a later stage (i.e. in candidate index number order, where this is known; see item B.1 below). Show the teaching group or set for each candidate. The initials of the teacher may be used to indicate group or set.
3. Transfer each candidate's marks to this form as follows:
   (a) Where there are columns for individual skills or assignments, enter the marks initially awarded (i.e. before internal moderation took place).
   (b) In the column headed 'Total Mark', enter the total mark awarded before internal moderation took place.
   (c) In the column headed 'Internally Moderated Mark', enter the total mark awarded *after* internal moderation took place.
4. Both the teacher completing the form and the internal moderator or moderators (where required) should check the form and complete and sign the bottom portion.

B. PROCEDURES FOR EXTERNAL MODERATION

1. University of Cambridge International Examinations (CIE) sends a computer-printed Coursework mark sheet MS1 to each centre (in late March for the June examination and in early October for the November examination) showing the names and index numbers of each candidate. Transfer the total internally moderated mark for each candidate from the Coursework Assessment Summary Form to the computer-printed Coursework mark sheet MS1.
2. The top copy of the computer-printed Coursework mark sheet MS1 must be despatched in the specially provided envelope to arrive as soon as possible at CIE but no later than 30 April for the June examination and 31 October for the November examination.
3. CIE will select a list of candidates whose work is required for external moderation. As soon as this list is received, send the candidates' work with the corresponding Individual Candidate Record Cards, this summary form and the second copy of MS1 to CIE. Indicate the candidates who are in the sample by means of an asterisk (*) against the candidates' names.
4. CIE reserves the right to ask for further samples of Coursework.
5. Send, with the sample work, instructions given to candidates and information as to how internal moderation was carried out.

DESIGN AND TECHNOLOGY
Coursework Assessment Summary F
IGCSE 2013

Please read the instructions printed on the previous page and the General Coursework Regulations before completing this form.

Centre Number		Centre Name		June/November	2 0 1 3

Candidate Number	Candidate Name	Teaching Group/ Set	Analysis of Need, Formulation of Brief (max 5)	Research into Design Brief Resulting in Specification (max 10)	Generation and Exploration of Ideas (max 20)	Developm't of Proposed Solution (max 15)	Planning for Production (max 10)	Product Realisation (max 30)	Testing and Evaluation (max 10)	Total Mark (max 100)	Internally Moderated Mark (max 100)

Name of teacher completing this form		Signature		Date	
Name of internal moderator		Signature		Date	

7. Additional information

7.1 Guided learning hours

IGCSE syllabuses are designed on the assumption that candidates have about 130 guided learning hours per subject over the duration of the course. ('Guided learning hours' include direct teaching and any other supervised or directed study time. They do not include private study by the candidate.)

However, this figure is for guidance only, and the number of hours required may vary according to local curricular practice and the candidates' prior experience of the subject.

7.2 Recommended prior learning

Candidates beginning this course are not expected to have studied Design and Technology in a formal way previously.

7.3 Progression

IGCSE Certificates are general qualifications that enable candidates to progress either directly to employment, or to proceed to further qualifications.
Candidates who are awarded grades C to A* in IGCSE Design and Technology are well prepared to follow courses leading to AS and A Level Design and Technology, or the equivalent.

7.4 Component codes

Because of local variations, in some cases component codes will be different in instructions about making entries for examinations and timetables from those printed in this syllabus, but the component names will be unchanged to make identification straightforward.

7.5 Grading and reporting

IGCSE results are shown by one of the grades A*, A, B, C, D, E, F or G indicating the standard achieved, Grade A* being the highest and Grade G the lowest. 'Ungraded' indicates that the candidate's performance fell short of the standard required for Grade G. 'Ungraded' will be reported on the statement of results but not on the certificate. For some language syllabuses CIE also reports separate oral endorsement grades on a scale of 1 to 5 (1 being the highest).

7. Additional information

Percentage uniform marks are also provided on each candidate's statement of results to supplement their grade for a syllabus. They are determined in this way:

- A candidate who obtains…
  … the minimum mark necessary for a Grade A* obtains a percentage uniform mark of 90%.
  … the minimum mark necessary for a Grade A obtains a percentage uniform mark of 80%.
  … the minimum mark necessary for a Grade B obtains a percentage uniform mark of 70%.
  … the minimum mark necessary for a Grade C obtains a percentage uniform mark of 60%.
  … the minimum mark necessary for a Grade D obtains a percentage uniform mark of 50%.
  … the minimum mark necessary for a Grade E obtains a percentage uniform mark of 40%.
  … the minimum mark necessary for a Grade F obtains a percentage uniform mark of 30%.
  … the minimum mark necessary for a Grade G obtains a percentage uniform mark of 20%.
  … no marks receives a percentage uniform mark of 0%.

Candidates whose mark is none of the above receive a percentage mark in between those stated according to the position of their mark in relation to the grade 'thresholds' (i.e. the minimum mark for obtaining a grade). For example, a candidate whose mark is halfway between the minimum for a Grade C and the minimum for a Grade D (and whose grade is therefore D) receives a percentage uniform mark of 55%.

The uniform percentage mark is stated at syllabus level only. It is not the same as the 'raw' mark obtained by the candidate, since it depends on the position of the grade thresholds (which may vary from one session to another and from one subject to another) and it has been turned into a percentage.

7.6 Resources

Copies of syllabuses, the most recent question papers and Principal Examiners' reports for teachers are available on the Syllabus and Support Materials CD-ROM, which is sent to all CIE Centres.

Resources are also listed on CIE's public website at **www.cie.org.uk**. Please visit this site on a regular basis as the Resource lists are updated through the year.

Access to syllabuses, recent question papers, Principal Examiners' Reports and regularly updated resource lists may be found on the CIE Teacher Support website at **http://teachers.cie.org.uk**. This website is available to teachers at registered CIE Centres.

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