Oxford Cambridge and RSA Examinations

RECOGNISING ACHIEVEMENT

OCR GCSE IN DESIGN AND TECHNOLOGY (ELECTRONIC PRODUCTS) 1953

Key Features

- Covers National Curriculum order for Key Stage 4 Design and Technology.
- Coursework clearly linked to teaching content requirement.
- A range of suitable tasks for coursework.
- Immediate support from specialist subject officer.
- Short Course also available.
- Moderation by visit.

Support and In-Service Training for Teachers

- A full programme of In-Service training meetings arranged by the Training and Customer Support Division (telephone 01223 552950).
- Specimen question papers and mark schemes, available from the Publications Department (telephone 0870 8706622, fax 0870 8706621).
- Past question papers and mark schemes, available from the Publications Department (telephone 0870 8706622, fax 0870 8706621).
- Written advice on coursework proposals.
- A report on the examination, compiled by senior examining personnel after each examination session.
- Individual feedback to each Centre on the moderation of internally assessed work.

CONTENTS

Throughout the specification the following icons are used to signpost teaching and learning opportunities in:

 Citizenship

 ICT

 Key Skills

Key Skills Reference

CO	Communication
N	Application of Number
IT	Information Technology
WO	Working with Others
LP	Improving own Learning and Performance
PS	Problem Solving

OCR GCSE IN DESIGN AND TECHNOLOGY (ELECTRONIC PRODUCTS) (1953)

SECTION A: SPECIFICATION SUMMARY

Outline

The revised GCSE specification retains the characteristics of the Design and Technology (Electronic Products) specification previously offered by OCR.

The revised specification provides a coherent, satisfying and worthwhile course of study for candidates, whether they wish to pursue the study of Design and Technology in the future or whether it will be their last experience of studying the subject.

The specification meets the National Curriculum Order for England (DfEE/QCA 1999) for Design and Technology and the GCSE Subject Criteria (QCA 2000). It provides opportunities for candidates to develop an awareness for the nature and significant importance of Design and Technology in a rapidly changing society. It enables candidates to develop their application of knowledge , skills, and understanding of Electronic Products within an overall design and make based approach. The specification offers a system of assessment for GCSE based on clear targets and coherent set of criteria for rewarding positive achievement across grades G to A*. The assessment of candidates includes both practical capability in Design and Technology applied to designing and making a product, and the knowledge and understanding which underpins this capability.

The specification is fundamentally designed to assess a candidate's capability at the end of KS4. It does, however, recognise that appropriate experiences at KS3 are essential if a candidate is to realise his/her full potential. This specification also provides candidates with a path into AS/A Level Design and Technology and GNVQ Manufacturing and Engineering.

TIERS

<table>
<tr><th>Grades</th><th>Foundation Tier
G to C</th><th>Higher Tier
D to A*</th></tr>
<tr><td>A*</td><td rowspan="3"></td><td rowspan="4">Candidates take
Components 2, 4
and 5</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="5">Candidates take
Components 1, 3
and 5</td></tr>
<tr><td>D</td><td></td></tr>
<tr><td>E</td><td></td></tr>
<tr><td>F</td><td></td></tr>
<tr><td>G</td><td></td></tr>
</table>

COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1 (Foundation)	1 hour	20%
2	Paper 2 (Higher)	1 hour 15 mins	20%
3	Paper 3 (Foundation)	1 hour	20%
4	Paper 4 (Higher)	1 hour 15 mins	20%
5	Internal Assessment (Coursework)	40 hours	60%

QUESTION PAPERS

Papers 1, 2, 3 and 4 will test a candidate's knowledge and understanding of Electronic Products through questions on designing and making. There will be no choice of questions.

Papers 1 and 2 will include a product analysis question based on information contained in the question paper. The focus of this product analysis question will **not** follow that of the published theme for papers 3 and 4.

Papers 3 and 4 will include a product analysis question, set on a different theme each year. The theme is printed in the specification with further, detailed information, provided at the beginning of the year of the examination.

INTERNAL ASSESSMENT (COURSEWORK)

Internal Assessment (coursework) will consist of a project where candidates will be expected to design and make a quality Electronic Product.

The project can be linked to a candidate's own interests, industrial practice or the community.

Projects may involve an enterprise activity, where candidates identify an opportunity, design to meet a need, manufacture products and evaluate the whole design and make process.

Candidates must use appropriate ICT to help with their work. This can include computer-aided design and manufacture (CAD/CAM) software, control programs, data analysis and ICT based sources for research.

Candidates must consider how technology affects society and their own lives.

ENTRY OPTIONS

Foundation and Higher

All candidates should be entered for 1953 with one of the following option codes:

Option Code	Option	Components
F	Foundation Tier	1, 3, 5
H	Higher Tier	2, 4, 5

SECTION B: GENERAL INFORMATION

1 Introduction

1.1 RATIONALE

The specification aims to prepare candidates to participate in tomorrow's rapidly changing technologies.

The specification calls for candidates to become autonomous and creative problem solvers, as individuals and members of a team. They must look for needs, wants and opportunities and respond to them by developing a range of ideas and making products and systems. This specification combines practical skills with an understanding of aesthetics, social and environmental issues, function and industrial practices. Candidates reflect on and evaluate relevant present and past design and technology, its uses and effects.

The specification seeks to help candidates to become discriminating and informed users and innovators of products. It encourages candidates to think and intervene creatively to improve the quality of life for society.

The specification provides a framework which can be accessed by all candidates with the potential of gaining a GCSE grade G to A*.

OCR has taken great care in the preparation of this specification and assessment material to avoid bias of any kind.

1.2 CERTIFICATION TITLE

This specification will be shown on a certificate as:

OCR GCSE in Design and Technology (Electronic Products)

1.3 LEVEL OF QUALIFICATION

GCSE Full Course:

This qualification is approved by the regulatory authorities (QCA and ACCAC) as part of the National Qualifications Framework for England and Wales.

Candidates who gain grades G to D will have achieved an award at Foundation Level.

Candidates who gain grades C to A* will have achieved an award at Intermediate Level.

1.4 RECOMMENDED PRIOR LEARNING

Candidates who are taking courses leading to this qualification at KS4 should normally have followed the corresponding KS3 programme of study within the National Curriculum.

Candidates entering this course should have achieved a general educational level equivalent to National Curriculum Level 3, or a distinction at Entry Level within the National Qualifications Framework.

1.5 PROGRESSION

GCSE qualifications are general qualifications which enable candidates to progress either directly to employment, or to proceed to further qualifications.

Many candidates who enter employment with one or more GCSEs would undertake training or further part-time study with the support of their employer.

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly grades G to D at GCSE could either strengthen their base through further study of qualifications at Foundation Level within the National Qualifications Framework or could proceed to Intermediate level. Candidates who are awarded mainly grades C to A* at GCSE would be well prepared for study at Advanced Level within the National Qualifications Framework.

Specifically students who achieve a grade C or above would be well prepared to study AS/A Level Design and Technology and GNVQ Manufacturing and Engineering.

1.6 OVERLAP WITH OTHER QUALIFICATIONS

Specifically, two GCSEs at grade G to D or two GCSEs at grade C to A* are equivalent to Part One GNVQ at Foundation and Intermediate Level respectively.

Four GCSEs at grade G to D or four GCSEs at grade C to A* are equivalent to full award GNVQ at Foundation and Intermediate Level respectively.

The format of this specification is shared with other specifications in the Design and Technology suite. The very nature of designing and making means that processes are similar, however, the content that is examined in the papers and internal assessment of the specification is unique to this specification.

Of a more general nature this specification provides opportunities to promote knowledge and understanding of a wide range of skills, many of which are shared with other subject areas.

Those identified in the National Curriculum Order for England (DfEE/QCA 1999) for Design and Technology are :

- **thinking skills**, identifying relevant sources of information, and developing criteria for designs to guide their thinking;
- **financial capability**, through taking account of the relative cost of materials and components, in relation to their working characteristics and properties when deciding if, when and how to use them;
- **enterprise and entrepreneurial skills,** through identifying an opportunity to design something to meet a specific need, finding out about the work of professional designers and the manufacturing industry and then making and marketing the prototype product, and evaluating the whole process;
- **work-related learning,** through bringing a realistic industrial or commercial perspective to the development of a product in school based design studios or areas, visiting a workplace for hands-on experience related to designing and making, and providing the opportunity for visitors from business to act as product advisers or clients;
- **education for sustainable development**, through developing knowledge and understanding of the principles of sustainable design and production systems, developing skills in creative problem solving and evaluation, and exploring values and ethics in relation to the application of design and technology.

1.7 RESTRICTIONS ON CANDIDATE ENTRIES

Candidates who enter for this GCSE specification **may not** also enter for any other GCSE specification with the certification title Design and Technology (Electronic Products) or Design and Technology (Systems and Control) in the same examination series.

Candidates who enter for this GCSE may however also enter for any GNVQ specification with the certification title GNVQ Manufacturing, GNVQ Engineering, GNVQ CBE in the same examination series. They may also enter for any NVQ qualification.

Every specification is assigned to a national classification code indicating the subject area to which it belongs.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

The classification code for this specification is 9010

1.8 CODE OF PRACTICE REQUIREMENTS

These specifications will comply in every respect with the revised Code of Practice requirements for courses starting in September 2001.

1.9 STATUS IN WALES AND NORTHERN IRELAND

This specification has been approved by ACCAC for use by Centres in Wales

Candidates in Wales and Northern Ireland should not be disadvantaged by terms, legislation or aspects of government that are different from those in England. Where such situations might occur, including in the external assessment, the terms used have been selected as neutral, so that candidates may apply whatever is appropriate to their own situation.

OCR provides specifications, assessments and supporting documentation only in English.

Further information on the provision of assessment materials in Welsh and Irish may be obtained from the OCR Information Bureau (telephone 01223 553998).

2 Specification Aims

The specification requires candidates to demonstrate fully their design and technology capability by combining skills with knowledge and understanding, in order to design and make quality products.

The specification allows candidates to acquire and apply knowledge, skills and understanding through:

(i) analysing and evaluating products and processes;

(ii) engaging in focussed tasks to develop and demonstrate techniques;

(iii) engaging in strategies for developing ideas, planning and producing products;

(iv) considering how past and present design and technology, relevant to a designing and making context, affects society;

(v) recognising the moral, cultural and environmental issues inherent in design and technology.

The aims of this specification are:

- to encourage candidates to combine their designing and making skills with knowledge and understanding, in order to design and make quality products;
- to promote design and technology capability in candidates through activities which involve a range of contexts, materials and processes and to lead to practical outcomes;
- to give opportunities to develop practical abilities and the confidence to design, make and modify products for identified purposes, selecting and using resources effectively;
- to promote the use of graphic techniques and ICT including computer-aided design (CAD), to generate, develop, model and communicate design proposals;
- to promote the use of computer-aided manufacture (CAM) in single item production and in batch or volume production;
- to encourage the development of candidates' critical and aesthetic abilities, enabling them to evaluate design and technology activity, including their own, in the context of an identified need;
- to encourage the development of candidates' understanding of the needs and values of a range of users; including spiritual, moral, social, and cultural considerations;
- to promote the keys skills of communication, application of number, IT, working with others, improving learning and performance and problem solving;
- to encourage the development of candidates' thinking skills, financial capability, enterprise and entrepreneurial skills;
- to encourage the development of candidates' understanding of work-related learning and the principles of sustainable design and production systems;
- to encourage candidates to consider how present and past design and technology, relevant to a designing and making process, affects society;
- to encourage candidates to consider the uses and affects of new technologies and modern materials on product design and manufacture;
- to provide for activities which give candidates opportunities to work both individually and as a member of a team.

Most of these aims are reflected in the assessment objectives, others, due to their very nature, cannot be readily assessed.

3 Assessment Objectives

The assessment objectives are designed to reflect the programme of study for Design and Technology.

Within this specification candidates will need to demonstrate their ability to:

- develop, plan and communicate ideas;
- work with tools, equipment, materials and components to produce quality products;
- evaluate processes and products;
- understand materials and components;
- understand systems and control.

The GCSE Subject Criteria (QCA 2000) sets out three specification Assessment Objectives for the scheme of assessment:

AO1 Capability through acquiring and applying knowledge, skills and understanding of materials components, processes, techniques and industrial practice;

AO2 Capability through acquiring and applying knowledge, skills and understanding when designing and making quality products;

AO3 Capability through acquiring and applying knowledge, skills and understanding when evaluating processes and products; and examining the wider effects of design and technology on society.

Assessment Components 1 - 4 Terminal Examination papers

These will test candidates' specialist knowledge, skills and understanding of Electronic Products through questions on the subject content (Section 5) outlined in the specification.

Assessment Component 5 Internal Assessment (coursework)

Internal Assessment (coursework) will test the knowledge, skills and understanding necessary to design and make products in the appropriate media. The evidence required to be submitted for this task must include a 3 dimensional product with a concise portfolio and/or appropriate ICT evidence.

Internal assessment will be evaluated against the following six internal assessment objectives: (see guidance Section 7.3.2)

- identify a need or opportunity that leads to a design brief;
- conduct research into the design brief which results in a specification;
- generate possible ideas for a solution;
- develop the product for manufacture;
- plan and realise the product;
- evaluate and test the product.

4 Scheme of Assessment

4.1 TIERS

The scheme of assessment consists of two tiers: Foundation Tier and Higher Tier. Foundation Tier assesses grades G to C and Higher Tier assesses grades D to A*. Candidates must be entered for either the Foundation Tier or the Higher Tier.

Under no circumstances will a candidate entered for the Foundation Tier be awarded a grade higher than grade C. Candidates on the Higher Tier who fail to achieve the minimum mark for the award of a grade D will normally be ungraded. There is however provision for those who narrowly fail to achieve this mark to be awarded a grade E.

<table>
<tr><th>Grades</th><th>Foundation Tier
G to C</th><th>Higher Tier
D to A*</th></tr>
<tr><td>A*</td><td rowspan="3"></td><td rowspan="3">Candidates take
Components 2, 4
and 5</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="5">Candidates take
Components 1, 3
and 5</td><td rowspan="5"></td></tr>
<tr><td>D</td></tr>
<tr><td>E</td></tr>
<tr><td>F</td></tr>
<tr><td>G</td></tr>
</table>

4.2 COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1 (Foundation)	1 hour	20%
2	Paper 2 (Higher)	1 hour 15 mins	20%
3	Paper 3 (Foundation)	1 hour	20%
4	Paper 4 (Higher)	1 hour 15 mins	20%
5	Internal Assessment (Coursework)	40 hours	60%

4.3 QUESTION PAPERS

Each question paper will contain five questions reflecting the grades targeted. Responses from candidates will be required in the form of one word, sentences and sketches with supporting notes.

Papers 1 and 2 will include a product analysis question based on information contained in the question paper. The focus of this product analysis question will **not** follow that of the published theme for papers 3 and 4.

Papers 3 and 4 will include a product analysis question, set on a different theme each year. Candidates will need to study this theme in order to answer the product analysis question fully. Research material, scrapbooks etc. cannot be taken into the examination.

The theme for 2003: Supermarket Checkouts.

Further detailed information will be provided early in 2003.

A formulae sheet (OCR tables 2) is provided by OCR for candidate use in examinations.

4.4 WEIGHTING OF ASSESSMENT OBJECTIVES (AO1, 2, 3)

The relationship between the components and the specification assessment objectives of the scheme of assessment is shown in the following grid:

Foundation Tier

Component	AO1	AO2	AO3	Total
1	4%	12%	4%	20%
3	4%	12%	4%	20%
5	12%	36%	12%	60%
Overall	20%	60%	20%	100%

Higher Tier

Component	AO1	AO2	AO3	Total
2	4%	12%	4%	20%
4	4%	12%	4%	20%
5	12%	36%	12%	60%
Overall	20%	60%	20%	100%

4.5 ENTRY OPTIONS

All candidates should be entered for 1953 with one of the following option codes:

Option Code	Title	Components
F	Foundation Tier	1, 3, 5
H	Higher Tier	2, 4, 5

4.6 INTERNAL ASSESSMENT (COURSEWORK)

The Internal Assessment will consist of **one** project where candidates will be expected to design and make a quality Electronics Product. This project requires a design and make activity related to industrial/commercial practices, and the appropriate application of systems and control.

The product can be linked to a candidate's own interests, industrial practice or the community. Projects may involve an enterprise activity, where candidates identify an opportunity, design to meet a need, manufacture products and evaluate the whole design and make process.

Candidates must use appropriate ICT to help with their work, including computer-aided design and manufacture (CAD/CAM) software, control programs, data analysis and ICT based sources for research.

Through their project, candidates must consider how relevant technology affects society and their own lives.

The evidence required to be submitted for this project must include a 3 dimensional product with a concise portfolio and/or appropriate ICT evidence. The whole activity must not exceed 40 hours of work.

If candidates work in groups, each candidate must take responsibility for a uniquely definable aspect of the overall project and undertake unique research, product design, manufacture and evaluation of that project aspect. Each candidate must provide unique evidence for assessment against the six internal assessment objectives with additional evidence in internal assessment objective 6 (evaluation and testing) to indicate the performance of the candidate's design within the context of the performance of the overall project.

Examples of appropriate tasks are given in Section 6.

Full details of the internal assessment objectives for internally assessed work can be found in Section 7.

4.7 ASSESSMENT OF PRESENTATION AND ICT

Overall presentation skills are assessed in the internally assessed component only. Please refer to guidance in section 7.

The assessment of this course requires candidates to use ICT through preparing, presenting, and reviewing information as they work on their design ideas, developing models that communicate these ideas, and making products using computer-aided manufacture (CAM).

4.8 DIFFERENTIATION

Differentiation will be achieved by tiered papers in the terminal examination and by task and outcome in the Internal Assessment. The internal assessment tasks undertaken by each candidate should reflect their capabilities. Exemplar tasks will be available (see Section 6).

4.9 AWARDING OF GRADES

The written papers will have a total weighting of 40% and internal assessment a weighting of 60%.

A candidate's mark for each of the components taken will be combined in the appropriate weighting to give the candidate's total mark for the specification. The candidate's grade will be determined by this total mark.

Candidates achieving less than the minimum mark for grade G will be ungraded.

Candidates on the Higher Tier who fail to achieve the minimum mark for the award of a grade D will normally be ungraded. There is however provision for those who narrowly fail to achieve this mark to be awarded a grade E.

4.10 GRADE DESCRIPTIONS

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by the candidates awarded particular grades. The descriptions must be interpreted in relation to the content specified in Section 5; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the overall assessment objectives. Shortcomings in some aspects of the assessment may be balanced by better performance in others.

Grade F

When applying their knowledge, skills and understanding to design and make products, candidates:

- draw on and use various sources of information;
- clarify their ideas through discussion, drawing and modelling;
- use their understanding of the characteristics of familiar products when developing and communicating their own ideas;
- work from their own plans, modifying them where appropriate;
- work with a range of tools, materials, equipment, components and processes with some precision;
- check their work as it develops and modify their approach in the light of progress;
- test and evaluate their products, showing that they understand the situations in which their designs will have to function and are aware of resources as a constraint;
- evaluate their use of basic information sources.

Grade C

When applying their knowledge, skills and understanding to design and make products, candidates:

- use a wide range of appropriate sources of information to develop ideas;
- use a range of strategies to develop ideas, responding to information they have identified;
- investigate form, function and production processes and communicate ideas, using appropriate media;
- recognise the needs of users and develop realistic designs;
- produce plans that make use of time and resources to carry out the main stages of making products;
- work with a range of tools, materials, equipment, components and processes, taking account of their characteristics;
- organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision;
- adapt their methods of manufacture to changing circumstances, providing a sound explanation for any change from the initial specification;
- select appropriate techniques to test and evaluate how their products would perform when used and modify their products in the light of ongoing evaluation to improve their performance;
- evaluate their use of information sources.

Grade A

When applying their knowledge, skills and understanding to design and make products, candidates:

- seek out and use information to help their detailed design thinking, and recognise the needs of a variety of client groups;
- are discriminating in their selection and use of information sources to support their work;
- they use a wide range of strategies to develop appropriate ideas, responding to information they have identified;
- investigate form, function and production processes and communicate ideas using a variety of appropriate media;
- recognise the different needs of a range of users when developing fully realistic designs;
- when planning, they make sound decisions on materials and techniques based on their understanding of the physical properties and working characteristics of materials;
- work from formal plans that make the best use of time and resources;
- work with a range of tools, equipment, materials and components to a high degree of precision;
- make products that are reliable and robust and that fully meet the quality requirements given in the design proposal;
- identify conflicting demands on their design, explain how their ideas address these demands and use this analysis to produce proposals;

- identify a broad range of criteria for evaluating and testing their products, clearly relating their findings to the purpose for which the products were designed and the appropriate use of resources;
- fully evaluate their use of information sources.

SECTION C: SPECIFICATION CONTENT

5 Introduction

During the key stage, candidates should be taught the knowledge, skills and understanding through: (N.C. order reference paragraph number)

- product analysis (6a);
- focused practical tasks that develop a range of techniques, skills, processes and knowledge (6b);
- design and make assignments, which include activities related to industrial practices and the application of systems and control (6c).

This section is set out in column format to help teachers relate the requirements of the specification content with experiences that would be applicable.

Design and Technology, by its very nature, is continually developing. Teachers should be aware of new developments when preparing candidates for this examination.

The subject content in this section will be tested in the terminal examination. In addition candidates must address this content in their project work.

All the subject content in this section applies to the GCSE (Full Course). The content written in *italics* will only be tested in Examination Papers 3 and 4.

5.1 DESIGNING AND MAKING

5.1.1 Developing and Writing a Design Brief (1a)

 C1.2, C2.2; WO1.1, WO1.2, WO2.1, WO2.2; LP2.1; PS2.1

Candidates should be able to: (N.C. order reference paragraph number)		**Range of activities:**
(a)	provide a detailed description of the design need using various means of communication;	text, drawings, photographs, graphs, *media clippings*
(b)	extract from verbal, visual and statistical information the essential problems to be solved;	life styles, popular activities, media publicity, consideration of information, *professional advice and market research* to identify the situation and design brief
(c)	identify the range of users and the market for which the product is intended;	questionnaires, surveys, influences of trends, potential market possibilities
	(1b)	
(d)	develop a design brief for a marketable product.	a clear statement of design intention linked to either the candidates own interests, home, industrial practice or the community

5.1.2 Drawing up a Specification

 IT1.1; WO1.1, WO1.2, WO2.1; LP1.1; PS1.1

Candidates should be able to:	Range of activities:
(a) examine the intended purpose of the product;	observation, consideration of existing products past and present
(b) identify and collect data relevant to the product(s) and its users; (1b)	i.e. dimensions, existing data or candidates own research, anthropometric data, observation, British and European standards i.e. ISO, BS, EN, DIN, CE mark
(c) consider issues that affect planning;	appropriate environmental *and monetary* costs
(d) identify and evaluate how existing products fulfil the needs of their intended users;	market and product analysis, *market surveys*, in relationship *to moral, social, economic,* environmental *and cultural* factors
(e) demonstrate an ability to express the results of research and analysis in the form of a suitable detailed specification;	a written specification list of constraints, illustrated where necessary to convey full detailed information, cost, portability, safety, environment
(f) consider the capability required to manufacture in batch quantity. (1c)	consideration of possible systems that would control batch production

5.1.3 Generating Design Proposals

 IT1.2, IT2.1; WO1.1, WO1.2, WO2.1; LP2.2; PS1.2, PS2.1

Candidates should be able to:	Range of activities:
(a) generate and record a range of design proposals suitable for manufacturing in quantity; (1c)	ideas recorded in a combination of text and graphic techniques suitable block diagrams, circuits, packaging, product design, use of appropriate plugs, sockets, switches, etc.
(b) identify within those proposals the resources needed for the solution to be realised; (1e)	materials, components and processes
(c) evaluate their ideas against the specification and modify where necessary;	annotated comments about ideas
(d) consider whether ideas meet the original need; (3a)	compare generated ideas with the design specification criteria. *Use ICT for testing and evaluating circuit ideas.*
(e) understand the relevance of function and aesthetics;	Ergonomic consideration and appearance of design ideas
(f) use mock-up models to check on the idea feasibility;	prototype circuits, breadboarding, including the use of computer simulation software, 2D and 3D models
(g) identify, with reasons for selection/rejection, the chosen design proposal (s) for product development;	evidence to support choice and reasons for rejection
(h) use graphic techniques and ICT, including computer- aided design (CAD), to generate, develop, model and communicate design proposals. (1g)	graphic techniques and computer aided design (CAD) used to generate, *develop, model* and communicate design proposals flow charts, block diagrams, circuit diagrams, PCB layouts

5.1.4 Product Development

 IT2.2, WO1.1, WO1.2, WO2.1, LP1.2, PS2.2

Candidates should be able to:	Range of activities:
(a) conduct testing or trialling to make decisions on materials, production processess and selection of pre-manufactured standard components;	appropriate testing to determine: optimum sizes of product, materials, degree of accuracy, production method and appearance
(b) model the final design to determine the degree of accuracy required for the product to function as planned; (1g)	modification of component values and product packaging
(c) determine as a result of modelling, testing or trialling the critical dimensions and tolerances that will determine the method for production of a small batch; (1e)	mounting of PCB's, batteries, etc. determine all the details needed to manufacture the product in a batch of 50 using the facilities available. *Use CAD to model and test (Prodesktop, Autocad)*
(d) make any necessary modifications; (1f)	mounting of switches, sockets, etc. using appropriate marking and machining
(e) consider the possibilities and implications for batch production as well as for a prototype;	text, computer images, working drawings, PCB layout, material/components lists
(f) use graphic techniques and ICT, including computer-aided design (CAD), to generate, develop, model and communicate design proposals. (1g)	graphic techniques and computer-aided design (CAD) used to generate, develop, model and communicate design proposals

5.1.5 Product Planning

 WO2.2, LP1.1, LP2.1, PS2.2

Candidates should be able to:	Range of activities:
(a) produce and use a detailed plan of work including: • manufactured items; • materials; • equipment; • tools and processes; • consideration of health and safety issues against a realistic time schedule. (1d) (3b)	a proposed work plan which sets realistic deadlines *and identifies critical points*
(b) prepare materials economically allowing for waste and fine finish; use pre-manufactured standard components appropriately.	efficient material preparation *Use of database to identify components.*

5.1.6 Tools and Equipment

Candidates should be able to use a range of tools, equipment and processes effectively and safely, including: (2a)	**Range of activities**
(a) marking out and checking tools; (4a)	try square, dividers, callipers, scriber, centre punch, rule
(b) cutting and machining tools;	saws, files, drills
(c) general tools;	screwdrivers, soldering irons, wirecutters, strippers, pliers
(d) finishing materials;	suitable abrasive papers, finish appropriate for the purpose and materials used
(e) jigs and formers.	repetitive operations, i.e. holes, formers for line bending, formers for vacuum forming.
Graphical representation	
Candidates should be able to use computer software or drafting equipment to achieve a good standard of graphical representation.	access to 2D or 3D CAD software or drafting equipment
Use of colouring media	
Candidates should be able to use colouring media to enhance drawings.	access to a minimum range of colouring media: coloured pencils *marker pens or colour printing*
Use of tools and equipment for model making	
Candidates should be able to use tools and equipment to make 2 and 3 dimensional models.	access to scissors, craft knives, safety rules and cutting boards to cut paper, card, *foamboard and styrofoam*

5.1.7 Processes

C1.2, N1.2

Candidates should have an understanding of the following basic processes:	Range of activities
	(4b)
(a) select and use a range of appropriate construction and production methods;	PCB production, soldering
(b) plastics – wasting, fabricating and forming;	(strip heater) vacuum forming, CNC machines for producing moulds and tools.
(c) wood/metal – shaping, wasting;	sawing, filing, drilling
(d) finishes – select appropriate aesthetic and functional finishes for the material used and recognise the need to protect against decay and corrosion;	techniques for labeling i.e. varnish, powder coating, painting
(e) adhesives – be familiar with the use of common adhesives and their correct method of application.	PVA, contact, epoxy resin

5.1.8 ICT Applications

 IT1.1, IT1.2, IT2.2, IT2.3

Candidates should:	Range of activities:
(a) understand how CAD/CAM is used in industrial manufacturing;	books, videos etc., CD ROM, internet, use of data transferral, robotics used in production lines, *industrial visits*
(b) understand how CAD/CAM is used in the manufacture of single items and small batches. (2d)	use CNC lathe, milling machine, machining centre, vinyl cutter, PCB design and production *use DXF files to transfer designs from CAD to CAM.*
Candidates should use ICT where appropriate to:	
(c) desktop publish;	combine written information and graphics; *produce a questionnaire.*
(d) produce bar charts, pie charts etc. from data;	present results in a graphical form;
(e) produce graphics;	use using appropriate 2D or 3D software
(f) mould and size text, and/or graphics to suit requirements;	produce text in appropriate styles and sizes for presentation *and advertising/packaging;*
(g) aid Design and Technology activities;	use ICT appropriately to handle, model or Communicate design proposals; (i) research from a database, use the internet; (ii) present data in the form of tables or graphics (iii) *use a spreadsheet for costing or modelling;*
(h) utilise CAD; (1g)	create and manipulate a range of 2D/3D images, producing accurate dimensioned drawings, PCB masters *edit basic shapes to suit a particular project.*
(i) utilise CAM;	use a cutter-plotter, *engraver, machining centre*
(j) demonstrate an understanding of the use of CAD and CAM in the design and construction of electronic devices.	PCB and circuit design packages. Model circuits and use on-screen test equipment.

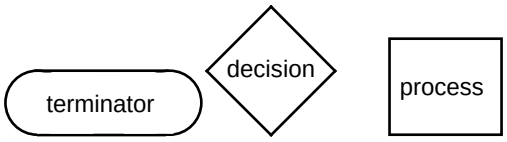
5.1.9 Industrial Applications

Candidates should be able to:		Range of activities:
(a) understand the following commercial production methods:	(2b)	
job production;		understand that this involves producing 'one off' products. Every item produced is different. It is labour intensive.
batch production;	(2c)	understand that this involves the production of a specified quantity of a product. Batches can be repeated as many times as required. This type of production method is flexible and can be used to produce batches of similar products with only a small change to the tooling.
repetitive flow;		*understand that this involves producing large numbers of identical products for a relatively low cost. The production is usually broken down into sub assemblies of smaller components. This form of mass production can be labour intensive or completely automated depending on the product being manufactured.*
continual flow process.		*understand that this involves uninterrupted 24 hrs/day production of a basic commodity such as steel, chemicals, oil or basic food products. This type of production continues because it is expensive to shut down and then re-start. Only a small workforce is needed to maintain the process.*
(b) understand the following commercial manufacturing systems:		
cell production;		*understand that this is a number of work stations grouped together to produce a single component*
in-line assembly;		*understand that this is used to mass produce many everyday items especially cars. Many in-line assembly systems are fully automated and only require people to ensure continual flow.*

	just in time;	*this philosophy requires materials, components and sub-assemblies to arrive from other factories 'just in time' for production. Finished products are despatched immediately they are made. This system reduces any storage of stock and allows for changes to the product to be made quickly without the need to use up stock items first.*
	logistics.	*understand that the production of products relies upon the availability of materials and components when required.*
(c)	understand the packaging, marketing, and advertising implications of a product;	information about the product, consumer preference, legislation, labelling, legal requirements, storage, distribution, *cultural and European influences.*
(d)	understand that control is a necessary part of production and marketing. (2c)	procedures to ensure a quality product *quality guarantees, consumer rights i.e. ISO 9000* understand that quality control helps to ensure that the customer is satisfied with a product. understand that a product should meet the criteria listed in the specification

5.1.10 Good Working Practice

LP2.3; WO2.2; LP1.1, LP2.2

Candidates should be able to:		Range of activities:
Devise strategies to make effective use of available resources to:		When planning their work candidates should be able to:
(a) produce process and block diagrams;		identify available materials, components, equipment and facilities; establish an order for work, identifying subtasks that need to be done first; organising their work to maximise the use of available time and resources.
(b) produce time plans and work schedules;	(1d)	produce time plans, flow charts *using standard symbols* 
(c) carry out testing, evaluation and modification of products.	(3b)	simple trialling of products; results collected, *charted and* analysed; relevant modifications made.

5.1.11 Product Evaluation

 C2.1a; WO1.3, WO2.3, LP2.3, PS1.3, PS2.3

Candidates should be able to:		Range of activities:
(a)	review their work at critical points and apply quality assurance techniques; (3b)	regular checks to ensure quality outcome
(b)	evaluate the proposed product against: its fitness for purpose; the design need; the needs of the intended user(s); (3c)	critical evaluation related to initial specification and use of resources
(c)	evaluate the proposed product against moral, cultural and environmental issues for the intended user;	sustainable sources of material supply and *disposal*/recycling of redundant products
(d)	review whether they have used materials and resources appropriately;	detailed testing with meaningful conclusions
(e)	carry out testing, resulting in conclusions that suggest necessary modifications. Analyse the performance of the manufacturing control system.	proposal for further development, suggest modifications or improvements to: (i) product (ii) jig, template or pattern

5.2 KNOWLEDGE AND UNDERSTANDING

5.2.1 Materials and Pre-manufactured Standard Components (4a, 4b, 4c 4d, 4e)

Technological Principles

Candidates should be able to:

- demonstrate a sound working knowledge of materials and composites;
- select materials relative to their characteristics, properties and performance;
- optimise cost and performance of materials to fulfil design requirements;
- identify and compare the following when selecting materials: conductivity, insulation properties (thermal and electrical), strength (compression, tension, shear, bending, torsion);
- understand the use of smart materials i.e. electroluminescent panels, memory metals, etc.

Construction Techniques

- build circuits using a variety of techniques i.e. breadboarding, etching;
- mount components appropriately i.e. on circuit boards and control panels;
- *understand industrial circuit board construction techniques for 'through hole' and 'surface mount' boards i.e. blocking many circuits onto one large board, use of machines for placing components, wave soldering, etc.;*
- awareness of new developments, trends, components and techniques in the electronics industry.

Basic Concepts

- describe current as a flow of charge normally carried by electrons;
- give examples of conductors and insulators;
- understand and apply the units used to measure current, voltage, resistance and capacitance including multiple and sub-multiple units.

Simple Circuits

- design simple circuits, in block diagram form involving a variety of inputs from sensors and outputs to lamps, motors, solenoids etc.

Ohm's Law

- use Ohm's law for simple calculations i.e. use and calculate the value of a current limiting resistor.

Power Calculations

- perform simple power calculations using P = V x I.

Resistors in series and parallel

- draw circuit diagrams containing resistors in series and parallel.

Resistor Calculations

- calculate the resistance of two or more resistors in parallel using:

$$\frac{1}{R_{TOTAL}} = \frac{1}{R_1} + \frac{1}{R_2} \text{ or } R_{TOTAL} = \frac{R_1 x R_2}{R_1 + R_2}.$$

Capacitor charging and discharging characteristics

- explain with the aid of diagrams and graphics the charging and discharging of a capacitor.

Capacitors

- use of capacitors in decoupling, smoothing and timing circuits.

Time Constant calculations

- use T = C x R to calculate simple time delays.

Alternating Current

- describe what is meant by an alternating current waveform.

Waveforms

- draw common waveforms i.e. sinusoidal, square; describe the meaning of peak frequency, cycle, and peak to peak voltage.

Testing Circuits

- use ammeters, voltmeters, and multimeters to measure current, voltage and resistance.

Transistor Circuit

- define current gain using Ie = Ib + Ic .
- complete simple calculations for NPN transistors based on:

$$h_{fe} = \frac{I_c}{I_b}$$

Potential Divider

- calculate the required values of resistance in potential divider circuits.

$$\text{Voltage out} = \frac{R_2}{R_1 + R_2} \times \text{Supply Voltage}$$

(Where R_1 is connected to supply voltage)

Operational Amplifier Calculations

- demonstrate an understanding of an op-amp used as a comparator
- *use the formula for an inverting amplifier*

$$Gain = \frac{-R_f}{R_{in}}.$$

- *use the formula for a non-inverting amplifier*

$$Gain = \frac{R_f + R_{in}}{R_{in}}$$

Standard Pre-manufactured Components

Candidates should be able to:

Power Supplies

- understand the use and limitations of different types of battery for energy storage purposes;
- select appropriate types for simple specified applications, i.e. dry cells, ni-cads lead-acid, lithium;
- *understand the use of voltage regulators i.e. 78 series. Have a theoretical understanding of power supply circuits, including transformers, diode rectification capacitor smoothing, voltage regulation and current regulation.*

Switches

- understand the action of common switches; toggle, push button, micro, rotary and reed and select for appropriate situations;
- understand the terms pole, throw, normally closed, normally open, change over and common in relation to switches and relays i.e. SPST, SPDT, DPDT;
- construct and draw circuits for switching high current loads, i.e. *FET or* relay for switching motors, solenoids, etc.

Resistors

- make use of a resistor colour code to determine the value and tolerance of a resistor and to select the nearest suitable preferred value, using the four-band code (the preferred values will come from the E12 series).

Capacitors

- select appropriate capacitors to suit applications;
- understand the term 'working voltage' of a capacitor;
- describe the physical construction and selection of common types of capacitor i.e. electrolytic, ceramic, polyester and tantalum;
- understand the use of capacitors to decouple an IC and smooth noise created by inductive transducers, i.e. dc motors.

Diodes

- understand the use of a diode as a one way conductor;
- use a diode in an inductive circuit to protect against back emf;
- use LED's in circuits and select a suitable current limiting resistor;
- understand the different characteristics of LED and LCD displays;
- *understand multiplexing as applied to multiple 7 segment displays.*

Transistors

- identify the base, emitter and collector lead of a bipolar junction transistor from a diagram or data sheet;
- recognise the symbols for NPN and PNP transistors;
- describe how current flow between collector and emitter can be controlled by the difference in voltage between the base and emitter;
- build simple circuits and sketch methods of biasing a transistor, e.g. single resistor, potential divider;
- be aware of the need for heat sinks to regulate temperature in power transistors;
- draw the circuit diagram and describe the use of the 'Darlington Pair' transistor configuration and be aware of transistor arrays, i.e. ULN 2003, ULN 2803;
- describe and explain the use of transistors in switching circuits.

FETs

- *use FETs in simple circuits.*

5.2.2 Systems and Control (5a)

Candidates should develop an understanding of control systems, to include:

Integrated Circuits

- explain what is meant by a dual-in-line package and identify pin numbers;
- *be aware of dedicated ICs i.e. melody generator from a greetings card, and explain the use of these from a technical data sheet.*

Operational Amplifiers

- Construct and draw circuits showing the use of an OP-AMP as a comparator in a single rail circuit, i.e. using a 3140;
- select suitable values of resistors for OP-AMP circuits;
- *an inverting amplifier and as a Non-inverting amplifier, explain the meaning of inverting and non-inverting inputs of an OP-AMP*; *741 or LM386, 3140;*
- design and construct a circuit involving a feedback resistor to control gain.

Timers

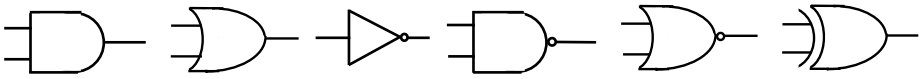
- use an IC to build an astable device for use in counting circuits, i.e. 4011 quad NAND, 555 timer;
- use an IC to provide a monostable circuit i.e. 4528B, 555 timer;
- output the clock pulses to an LED, loudspeaker, transistor or other IC;
- *demonstrate an understanding of the concept of mark to space ratio and draw waveforms to demonstrate this.*

Counting

- use the binary counting system to convert to and from decimal number up to 255;
- understand the terms bit and byte;
- use a four bit binary counter to count pulses from a transducer or from an astable signal, (transducer - photo-diode, pulse generator - 555 timer in astable mode and as a monostable);
- display a binary count using four LED's;
- understand the need for switch de-bouncing when pulsing a counter, i.e. RS latch;
- understand the need for rapid switching in a digital circuit, i.e. by using Schmitt trigger;
- *display a count using a seven segment display, i.e. using a 4026B.*

Logic

- explain the functions, AND, OR, NOT, NAND, NOR *and XOR gates*;
- explain why the AND gate is not considered safe in all applications involving transport
- recognise and draw the following symbols:



- construct truth tables for the above functions;
- solve simple logic problems using the logic functions in combination;
- *recognise simple Boolean expressions;*
- *perform NAND and NOR implementation;*
- *use suitable IC to produce a bistable circuit, i.e. NAND gate, NOR gate, JK type;*
- *understand the terms - edge trigger, set/re-set and toggle.*

Microcontrollers/microprocessors

- understand the use of microcontrollers as progammable interface controllers (PIC) with variable input/output configurations;
- understand that microcontrollers may contain internal analogue to digital (A/D) conversion capabilities;
- *understand the differences between a microprocessor (external RAM, EPROM and input/output ports) and microcontrollers.*

Transducers

- understand the use of the following transducers:
  LDR
  Photodiode
  Thermistor
  Microphone
- design and construct simple potential divider circuits using transducers.

Practical Applications

- design and make practical devices and systems;
- *design systems that integrate with other systems;*
- analyse simple electronic systems and recognise input, process and output circuits i.e. dividing circuits/systems into simpler sub-circuits/systems;
- *recognise when feedback is being used in control circuits and explain why this is necessary i.e. the use of negative feedback in Op-amp circuits;*
- understand the use of circuit simulation software to test sub-systems and complete circuits prior to physical testing.

Construction

- build circuits using a variety of techniques i.e. breadboarding and printed circuit production;
- mount components appropriately i.e. on circuit boards and control panels;
- understand the importance of correctly housing electronic circuits, i.e. shaping PCBs to fit in ergonomic cases, use of PCB mounting posts, ventilation holes to allow air circulation, etc., dust sealing, etc.*;*
- demonstrate the use of CAD CAM in the design and construction of electronic devices i.e. PCB designing packages, vinyl cutter, *use of predrawn component shapes when laying out circuit boards.*

5.2.3 Products and Applications (6a)

Candidates should be able to carry out a product analysis of commercially manufactured products and their applications. The process should include the following:

- establishing the function and application/s of the product;
- identifying the constituent parts of the product *and their interrelated functions;*
- establishing how the product works *including any scientific principles involved;*
- identifying the materials from which the product is manufactured*;*
- identifying the manufacturing processes used to make the product;
- *establishing the intended market for the product;*
- *assessing the performance of products against alternative artefacts and solutions;*
- *testing products using existing information regarding materials and processes.*

5.2.4 Quality (2c, 3d, 3c)

Candidates should understand how to distinguish between quality of design and quality of manufacture by drawing on their experience and understanding of existing products and applications including:

- an understanding of procedures that could be set during production to ensure control over quality;
- how far existing products satisfy their needs and fulfil their purpose i.e. a well made electronic toy that is of no interest to a child;
- when assembling products, candidates should understand the importance of accuracy;
- the appropriate use of resources and materials in relation to manufacture and maintenance i.e. use of lithium in batteries, polyester for capacitors;
- how it meets manufacturability and maintenance requirements;
- its social, moral, economic, environmental and aesthetic implications i.e. advantages and disadvantages of mobile phones, consideration of the style of the product, its *disposal and* recycling of materials and components.

5.2.5 Health and Safety (2a)

Candidates should understand health and safety as designers, manufacturers and consumers to include:

As designers and consumers:

- correct selection of materials and finishes;
- safety in terms of function and product maintenance;
- *workers within the production environment.*

As workers within the production environment:

- storage and use of tools and equipment;
- materials, chemicals, solvents, finishes;
- flammable and toxic substances.

Personal safety:

- protective wear including eye protection, clothing;
- machine guards;
- dust and fume extraction;
- disposal of waste;
- use of barrier creams;
- accident procedure.

Risk assessment – using information sources:

- COSHH i.e. fumes given off by some adhesives, etching chemicals;
- instructions relating to the use of consumables i.e. solvent cement, impact adhesives, superglue, etching chemicals;
- *instructions relating to the use of unfamiliar equipment i.e. portable power tools;*
- recognition and understanding of safety symbols (UK and European).

Environmental effects:

- the disposal of chemicals used to manufacture products;
- the reduction in the common use of chemicals dangerous to the environment i.e. bleaches, CFC's, toxic materials;
- the need to dispose of redundant products in a safe and environmentally friendly way.

SECTION D: COURSEWORK

6 Coursework Tasks

6.1 NATURE OF COURSEWORK PROJECT

Candidates are required to produce an Electronics product that can be marketed. The underlying influence on the project should be that the product will be the first of a batch of 50, realised in school/college with the facilities that are available. The candidate will realise the first, or the prototype of this product.

The evidence required to be submitted for assessment must include a 3 dimensional product with a concise portfolio (including evidence of modelling) and/or appropriate ICT evidence. Centres are reminded that ICT evidence must address the requirements of the six Internal Assessment Objectives. Evidence which does not lead to a finished product can be assessed if it is felt that it represents work appropriate to the focus of the project.

This project will be assessed against the following six internal assessment objectives:

1 identify a need or opportunity that leads to a design brief;

2 conduct research into the design brief which results in a specification;

3 generate possible ideas for a solution;

4 develop the product for manufacture;

5 plan and realise the product;

6 evaluate and test the product.

It is envisaged that the coursework project presented for assessment will represent 40 hours of work for the GCSE full course. Some of the work, by its very nature, may be undertaken outside school e.g. research work, testing etc.

6.2 EXEMPLAR COURSEWORK TASKS

Candidates may select one of the following statements as a starting point for the coursework project. Through investigating the statement, candidates can devise their own design brief based on their interests and ability.

It is not compulsory to select an area of design from this list. Teachers and/or candidates can devise their own starting point. OCR coursework consultants are available for advise, of required.

In order to contact coursework consultants, Centres should use Coursework Task Proposal forms supplied to Centres in a Coursework Administration Pack or download the form from the OCR website: www.ocr.org.uk.

1 The manager of a Garden Centre is trying to cut down labour costs involved in the business. Possible areas to be looked at are the temperature control, humidity control and plant watering.

2 A photographer is wanting to take pictures of a badger feeding at night. Not wanting to disturb the animal it is important to take the picture automatically.

3 Deaf competitors at swimming galas have difficulty in hearing the starter.

4 A small ensemble requires a portable device to help them get the timing of the music correct.

5 Consider the problem of caravan theft.

6 The scoreboards traditionally used for some sports such as snooker or darts have a number of disadvantages. Investigate.

7 Traditional spirit levels used in the building industry are accurate and reliable. An electronic level might have some advantages though, such as an easy to read display.

8 Employees in a shop often have to walk to the storeroom behind the shop with messages. Some kind of two-way voice communications system (intercom) between the two rooms would be very useful.

9 A small musical group requires a portable instrument tuner.

10 A keen gardener with a small greenhouse wants to go away on a two weeks holiday and requires an automatic plant watering system.

11 Car theft is increasing and some deterrent is an advantage. Design a burglar alarm system which can be simply fitted to most cars but which uses a range of sensors to detect any attempt to tamper with the car.

12 Personal stereos and CD players are very popular and are ideally suited for individual listening. Sometimes, however, it is useful to amplify sound so that a small group of people can listen together.

13 A small business requires only a limited number of employees to have access to a certain room.

14 Some amateur musicians like to make cassette recordings of their practice sessions. Design a simple audio mixer which can combine the signals from two or three microphones.

15 A digital stopwatch is used at athletics tracks to time races. To obtain a more accurate system.

16 Home computers can be used to record changes in temperature and sunlight. Investigate.

17 As an alternative to the traditional dice, for use on board games, it would be very useful to have an electronic dice which would display a number after the initial roll.

18 Cycle theft is increasing and a deterrant could be an advantage.

19 A random number generator for a mini lottery is needed for a school fete.

20 Many keen gardeners make use of their greenhouses throughout the year. Design a heating control system.

21 Many houses suffer from a damp problem which usually shows itself on the wallpaper or plaster work. Provide a way for the householder to identify and possibly trace the problem.

6.3 EXPANSION OF AN 'EXEMPLAR COURSEWORK TASK'

Task 18 – Cycle theft is increasing and a deterrent could be an advantage.

Internal Assessment Objective 1 - Identification of a need or opportunity leading to a design brief.

- An evaluation of the need for additional security for a cycle or its equipment when it is left for a short time.
- Consideration of the market possibilities for such a device and who would be the likely users.
- A clear statement of the problem and what the candidate intends to design and make as a marketable product.

Internal Assessment Objective 2 - Research into the design brief which results in a specification.

- Consider how cycles may be secured or what easily removed items should be protected.
- An interview, the results of which is analysed to determine the users requirements.
- Information, evaluated, to show how existing products satisfy the needs of the intended user.
- Relevant data evaluated.
- A specification, developed from the research data, which includes the capability to manufacture the product using batch production methods.

Internal Assessment Objective 3 - Generation of design proposals.

- A collection of annotated sketches, systems and circuit diagrams illustrating a range of proposals suitable for the security devise.
- The proposed ideas are evaluated against the specification in order to illustrate their suitability, some proposals may require modification in order to satisfy the fitness for purpose.
- The most promising ideas are clearly selected for further development.
- Design proposals are presented using a range of graphic techniques and ICT including computer aided design, to generate, develop, model and communicate design ideas. Two and three dimensional modelling could be used.

Internal Assessment Objective 4 - Product Development.

- The chosen circuit must be tested to ensure that it meets the original brief. CAD packages may be used or a suitable prototyping system. Modifications may be required to meet the specification.
- The circuit should be converted into a PCB design, suitable for batch production.
- An investigation into the most appropriate methods for securing the PCB, battery, sensor, output device etc. into the casing, with reasoned decisions for choice.
- The possibilities and implications for batch production are considered and recorded.
- A system to provide control over the manufacturing of the product should be developed. This should enable uniformity of the product throughout the batch to be maintained.
- Final details of the product should be presented using a range of graphic techniques and ITC including CAD, to develop, model and communicate the ideas.

Internal Assessment Objective 5 - Product planning and realisation.

- A plan of action is produced specifying an effective order for the sequence of operations. The plan may include resource implications for the manufacture of the product.
- The making demonstrates the economic and efficient use of production tools and materials, including the flexibility to adapt to changing circumstances.
- Safe working procedures are evident during the making.
- A range of appropriate skills and techniques including computer aided manufacturing are used effectively to produce a quality product.

Internal Assessment Objective 6 - Evaluation and Testing.

- The product is tested to ensure that it meets the original need and is fit for its intended purpose.
- The intended user should be involved in this process.
- The product is evaluated against the original specification.
- The control system itself should be evaluated.
- Proposals for further development are suggested with illustrations to show where improvements could be made to both the product and control system, used to aid batch production process.

7 Regulations for Internal Assessment

7.1 SUPERVISION AND AUTHENTICATION OF COURSEWORK PROJECTS

OCR expects teachers to supervise and guide candidates who are undertaking work which is internally assessed (e.g. coursework project). The degree of teacher guidance in candidates' work will vary according to the work being undertaken. It should be remembered, however, that candidates are required to reach their own judgements and conclusions.

When supervising internally assessed coursework projects, teachers are expected to:

- Offer candidates advice about how best to approach their work.
- Exercise continuing supervision of work in order to monitor progress and to prevent plagiarism.
- Ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the internal assessment objectives and procedures.

Internally assessed coursework projects should be completed in the course of normal curriculum time and supervised and marked by the teacher. Some of the work, by its very nature, may be undertaken outside the Centre e.g. research work, testing etc. As with all internally assessed work, the teacher must be satisfied that the work submitted for assessment is the candidate's own work.

7.2 PRODUCTION AND PRESENTATION OF INTERNALLY ASSESSED COURSEWORK PROJECTS

Candidates must observe certain procedures in the production of internally assessed work.

- Any copied material must be suitably acknowledged.
- Quotations must be clearly marked and a reference provided wherever possible.
- Work submitted for moderation must be marked with the:
  Centre number
  Centre name
  Candidate Number
  Candidate Name
  Specification title and code i.e. OCR GCSE in Design and Technology (Electronic Products) 1953
  Coursework project title.

7.3 MARKING CRITERIA FOR INTERNALLY ASSESSED WORK

This specification requires candidates to demonstrate fully their design and technology capability. They should combine skills with knowledge and understanding in order to design and make quality products.

The assessment objectives:

- of materials, components, processes, techniques and industrial practice (AO1);
- for designing and making quality products (AO2);
- for evaluating processes and products and examining the wider effects of design and technology on society (AO3),

are assessed, in an integrated way, through the six Internal Assessment Objectives shown below.

Internal Assessment Objectives		Specification Assessment Objectives		
		AO1	AO2	AO3
1	Identification of a need or opportunity leading to a design brief		**2**	**2**
2	Research into design brief resulting in a specification	**2**	**6**	**4**
3	Generation of design proposals	**2**	**8**	**2**
4	Product development	**6**	**4**	**2**
5	Product planning and realisation	**10**	**40**	**2**
6	Evaluation and Testing			**8**
	Total Marks	**20**	**60**	**20**

The weighting of the marks provides an indicator of the time that candidates should spend on each part of the project.

It is envisaged that the coursework project presented for assessment will represent 40 hours work. Some of the work, by its very nature, may be undertaken outside school e.g. research work, testing etc.

7.3.1 Assessment of the Overall Presentation of the Coursework Project

This specification provides for an assessment of the overall presentation of the coursework project. Marks are awarded on the basis of a candidate's overall performance in presenting work throughout the project portfolio. Details are given in Section 7.3.4.

7.3.2 Guidance for Teachers

It is appreciated that for assessment purposes, the Internal Assessment Objectives have been written in a linear form. However, within focus areas of Design and Technology, some stages may interrelate and be cyclical in approach.

This specification requires candidates to produce an electronic product that can be marketed. The underlying influence on the project should be that the product will be the first of a batch of 50, realised in school/college with the facilities that are available. The candidate will realise the first, or the prototype of this Electronic Product.

When identifying the need for the project, candidates must consider the situation in which the product would be used and should give details of the likely user. The design brief must be clearly stated. Research into the brief should include market research to investigate the views of potential users and a review of existing similar products. The results should be analysed making use of ICT facilities. Research material must be relevant to the brief and should be evaluated by the candidate. The conclusions drawn from the research should inform the specification which must be detailed and should include a reference to the batch production of the article.

Candidates should consider a range of solutions, both for the circuitry and the product casing, and these should be evaluated against the requirements of the specification. Reasons for selecting the chosen ideas must be clearly stated. With regard to the selection of an appropriate case for the product, either individually designed cases manufactured by the candidates or commercially made boxes are acceptable. It must be remembered however that with a purchased case it is the work that is put into modifying the basic box to allow it to accommodate the circuitry which gains credit. Where appropriate, candidates should consider the use of 'smart' and modern materials.

In order to check the suitability of the circuit and its casing 2d and 3d modelling and computer simulation should be considered. The development of the product should include all essential items which convert the circuit into a marketable product. The candidate will also provide details of a suitable system to ensure control over the quality of batch production.

To avoid costly and time consuming mistakes it is important that detailed planning is completed before the making takes place. The making should provide clear evidence of the candidates competence and could include the use of computer aided manufacturing. Once completed the product and control system must be tested and evaluated against the specification and suggestions for improvement should be made.

ICT should be used throughout the activities of designing and making where appropriate.

The final outcome should be a high quality 3 dimensional marketable electronics product capable of being produced in quantity.

7.3.3 Applying the Internal Assessment Objectives to Candidates' Work

Each internal assessment objective has four 'level of response' boxes containing hierarchical statements. Initially a 'best fit' should be established and the mark awarded within the appropriate mark range.

The marks have been broken down into ranges of marks for the hierarchical statements within each level of response box.

This breakdown enables positive marking of a coursework project by allowing the teacher to match statements from any of the level of response boxes against the evidence offered by the candidate.

This approach can be applied to each assessment objective using the marks in brackets [ ], as indicated.

For example when marking internal assessment objective 5, a project may reflect:

Little or no planning	[3]
Has overcome problems as they arise etc.	[6]
With a normal level of supervision, has combined a range of skills and techniques etc.	[9]
The product will exhibit a reasonable standard etc.	[8]
Total Mark	**26**

Internal Assessment Objective 1

TOTAL MARKS 4

Identification of a need or opportunity leading to a Design Brief	**Level of Response**	**Mark Range**
Candidates will need to: • provide a description of the design need using various means of communication; • identify the range of users and the market for which the product is intended; • develop a design brief for a marketable product.	A statement of what is to be made.	**0-1**
	Some consideration of the design need or the intended user/users leading to a design brief.	**2**
	Consideration of both the design need and the intended user/users leading to a clear design brief of a marketable product.	**3**
	Detailed description of both the design need and user/users leading to a clear and precise design brief of a marketable product.	**4**
	Total	**4**

Internal Assessment Objective 2

TOTAL MARKS 12

Research into the Design Brief which results in a Specification	Level of Response		Mark Range
Candidates will need to: • examine the intended purpose, form and function of the product; • undertake appropriate surveys, identifying and evaluating how existing products fulfill the needs of their intended users; • identify and collect data relevant to the product(s) and its users; • develop a detailed specification and criteria that includes the capability for batch production.	Limited research of intended use. Some recognition of existing products. A specification identifying some basic requirements.	[1] [1] [1]	**0-3**
	Intended use of product examined with some data identified or collected. Existing products identified with some evaluation. A specification identifying some key features including a suggestion of how more than one could be made.	[2] [2] [2]	**4-6**
	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 containing some reference to a system required to manufacture in batches.	[3] [3] [3]	**7-9**
	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 and information sources leading to a detailed design specification that would provide a system to ensure control over the production of the product in batches.	[4] [4] [4]	**10-12**
	Total		**12**

Internal Assessment Objective 3

TOTAL MARKS 12

Generation of Design Proposals	Level of Response		Mark Range
Candidates will need to: • generate a range of design proposals; • check design proposals against design specification and review and modify them if necessary; • identify chosen design proposal for product development; • present design solutions using a range of graphic techniques and ICT including computer-aided design (CAD), to generate, develop, model and communicate design proposals.	One or more solutions proposed. Little or no evaluation. The work displays a low standard of communication techniques.	[1] [1] [1]	**0-3**
	Several solutions proposed. A cursory evaluation. Unsupported choice of design proposal. Communication will be of a reasonable standard using a limited number of techniques.	[2] [2] [2]	**4-6**
	A range of appropriate solutions proposed. Design proposal chosen, supported by clear evaluation. Communication will be of a good standard, using a range of appropriate techniques.	[3] [3] [3]	**7-9**
	A wide range of appropriate solutions proposed. Design proposal chosen as a result of detailed evaluation and consideration of the need and fitness for purpose. Communication will be of a high quality, using a wide range of appropriate techniques.	[4] [4] [4]	**10-12**
		Total	**12**

Internal Assessment Objective 4

TOTAL MARKS 12

Product Development	Level of Response		Mark Range
Candidates will need to: as a result of investigation, testing or trialling, make reasoned decisions about: materials; production methods; pre-manufactured standard components. consider how materials are prepared for manufacture and how pre-manufactured standard components are used; by modelling, apply test procedures ensuring the product meets the original design brief and its fitness for purpose; consider when developing the product, the implications for quantity manufacture of: (i) materials and components; (ii) tools, equipment and processes; (iii) critical dimensions and tolerances. • develop a control system to be used in the manufacture of their product; • be flexible and adaptable in responding to changing circumstances and new opportunities; • make any necessary modifications to the chosen design; • give details of the final design including a final product specification; • present design solutions using a range of graphic techniques and ICT including computer-aided design (CAD), to develop, model and communicate design proposals.	Some materials and production methods identified. Has attempted to model part of final solution. Limited details given for final solution.	[1] [1] [1]	**0-3**
	As a result of investigations some decisions made about materials, production methods function and pre-manufactured items. Has used modelling to check that the product meets the design brief. Some important details given about the final product and how more than one of the product could be made.	[2] [2] [2]	**4-6**
	Some testing and trialling resulting in decisions about materials, production methods and pre-manufactured items. Used modelling and testing to ensure that the product meets the design brief. Most details given about final product and the control system needed to produce the product in quantity.	[3] [3] [3]	**7-9**
	Appropriate testing and trialling resulting in reasoned decisions about materials, production methods and pre-manufactured items. Has used modelling and test procedures to identify any necessary modifications and to ensure the product meets the design brief. Full details about the final product and the control system needed to produce the product in quantity.	[4] [4] [4]	**10-12**
		Total	**12**

Internal Assessment Objective 5

TOTAL MARKS 52

Product Planning and Realisation	Level of Response		Mark Range
Candidates will need to: • produce a plan of action which considers: materials, manufactured items, equipment, processes and health and safety issues against an order of work and the need to make products that match the design specification • select and use tools, equipment and processes effectively and safely • economically prepare materials/ manufactured items for production, allowing for waste and fine finish. • complete a quality outcome suitable for the intended user or users, ensure that their outcome functions effectively • be prepared to adapt working procedures in response to changing circumstances • use a range of skills and techniques appropriate to the task • where appropriate apply a range of industrial techniques when working with familiar materials and processes	Little or no planning. Has used a limited range of materials, tools and equipment With frequent prompting uses basic skills and techniques appropriate to the task. Little understanding of safe working practices. The product will exhibit a low standard of outcome and may not be successfully completed.	[3] [3] [3] [4]	**0-13**
	Planning will have been restricted to the immediate task and will have relied on prompting. 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.	[6] [6] [6] [8]	**14-26**
	Most of the realisation will have been planned in advance 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.	[9] [9] [9] [12]	**27-39**
	The realisation will have been thoroughly planned to specify an effective order for the sequence of operations. Are resourceful and adaptable with materials, tools and equipment and to a high degree of precision. 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 quality and will fully meet the requirements of the final product specification.	[12] [12] [12] [16]	**40-52**
		Total	**52**

Internal Assessment Objective 6

TOTAL MARKS 8

Evaluation and Testing	Level of Response		Mark Range
Candidates will need to: • evaluate their products to ensure that they are of a suitable quality for intended users; • carry out testing, resulting in reasoned conclusions that suggest any necessary modifications to improve the product; • review whether they have used resources appropriately e.g. time, materials, equipment, and production methods; • analyse the performance of their manufacturing control system in the production of the prototype.	Relevant unsupported comment with some reference to the specification No evidence of testing	[1] [1]	**0-2**
	Some supported comment with reference to the specification and use of resources Superficial testing with a conclusion	[2] [2]	**3-4**
	Relevant comments with reference to specification and use of resources Relevant testing with few conclusions, leading to a possible modification or improvement of product and/or system designed to control manufacture	[3] [3]	**5-6**
	Critical evaluation related to specification and use of resources Detailed testing with meaningful conclusions leading to proposals for further development, modification or improvements of product and system designed to control manufacture	[4] [4]	**7-8**
		Total	**8**

7.3.4 Assessment of the Overall Presentation of the Coursework Project

An assessment of the overall presentation of the project is provided for the internally assessed component of this specification.

Marks are awarded on the basis of a candidate's overall performance in presenting work throughout the project portfolio. Performance criteria are given below to assist with the allocation of marks.

Teachers should first assess the candidate's project portfolio against the six **Internal Assessment Objectives**. The performance criteria for presentation should then be applied, and marked according to the table given below.

Performance Criteria	Mark range
Below threshold performance	**0**
Threshold performance Candidates present their ideas with reasonable care in a format that can be followed.	**1**
Intermediate performance Candidates present their ideas with care in an appropriate sequence.	**2-3**
High performance Candidates present their ideas adeptly in a logical and concise way.	**4-5**

7.4 MODERATION

All internally assessed work is marked by the teacher and internally standardised by the Centre. Marks are then submitted to OCR by a specified date, after which moderation takes place in accordance with OCR procedures. The purpose of moderation is to ensure that the standard of the award of marks for internally assessed work is the same for each Centre and that each teacher has applied the standards appropriately across the range of candidates within the Centre.

The sample of work which is presented to the Moderator for moderation must show how the marks have been awarded in relation to the internal assessment objectives defined in Section 7.3.

Where it is not clear within a project folder, by the candidate's own presentation of work, where the marks have been awarded, annotation must be carried out by the person marking the work.

7.5 MINIMUM REQUIREMENTS FOR INTERNALLY ASSESSED WORK

There should be clear evidence that work has been attempted and some work produced.

If a candidate submits no work for an internally assessed component, then the candidate should be indicated as being absent from that component on the mark sheets submitted to OCR. If a candidate completes any work at all for an internally assessed component then the work should be assessed according to the internal assessment objectives and marking instructions and the appropriate mark awarded, which may be zero.

SECTION E: FURTHER INFORMATION

8 Opportunities for Teaching

8.1 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. Where appropriate, candidates should be given opportunities to use ICT in order to further their study of Electronic Products.

The assessment of this course requires candidates to use ICT through preparing, presenting, and reviewing information as they work on their design ideas, developing models that communicate these ideas, and making products using computer-aided manufacture (CAM).

This section offers guidance on opportunities for using ICT during the course. These opportunities are also indicated within the content of Section 5 by a  symbol. Such opportunities may or may not contribute to the provision of evidence for IT Key Skills. Where such opportunities do contribute, they are identified by the use of the  symbol.

ICT Application	Opportunities for using ICT during the Course
Database	Sections 5.1.1, 5.1.8, 5.1.11
Internet	Sections 5.1.2, 5.1.8
Word Processing	Sections 5.1.2, 5.1.8, 5.1.11
Spreadsheet	Sections 5.1.5, 5.1.8
CAD	Sections 5.1.3, 5.1.4, 5.1.6, 5.1.8
CAM	Sections 5.1.8, 5.1.9, 5.1.10

8.2 CITIZENSHIP

From September 2002, the National Curriculum for England at KS4 includes a mandatory programme of study for Citizenship. Parts of this programme of study may be delivered through an appropriate treatment of other subjects.

This section offers guidance on opportunities for developing knowledge, skills and understanding of citizenship issues during the course. These opportunities are also indicated within the content of Section 5 by a  symbol.

Citizenship	Opportunities for teaching Citizenship Issues during the Course
Consider the needs of others	Section 5.1.1
Consider issues surrounding a particular product and its surroundings	Section 5.1.2
Seek opinions of others and be flexible and adaptable in responding to their needs	Sections 5.1.3/4
Consider the need to work together as a team	Section 5.1.9
Seek the opinions of others	Section 5.1.11
Consider the health and safety of others	Section 5.2.5

8.3 SPIRITUAL, MORAL, ETHICAL, SOCIAL AND CULTURAL ISSUES

The specification provides opportunities to promote:

- spiritual development, through helping pupils recognise their own creativity and the creativity of others in finding solutions to problems, and through recognising the tension between material and non-material needs;
- moral development, through helping pupils to reflect on how technology affects the environment so they can make informed choices when designing and making and through discussing the moral dilemmas posed by introducing new technologies within different values systems and the advantages and disadvantages of new technology to local, national and global communities;
- social development, through helping pupils recognise the need to consider the views of others when discussing design ideas;
- cultural development, through exploring the contribution of products to the quality of life within different cultures, and through valuing and reflecting on the responses of people from other cultures to design solutions.

8.4 HEALTH, SAFETY AND ENVIRONMENTAL ISSUES

OCR has taken account of the 1988 Resolution of the Council of the European Community and the Report Environmental Responsibility: An Agenda for Further and Higher Education, 1993 in preparing this specification and associated specimen assessments.

The specification provides opportunities to promote education for sustainable development, through developing knowledge and understanding of the principles of sustainable design and production systems, developing skills in creative problem solving and evaluation, and exploring values and ethics in relation to the application of design and technology. Whilst candidates will not be specifically assessed in terms of their knowledge and awareness of issues associated with energy usage, it is anticipated that, whenever possible, candidates will be encouraged to consider the benefits and drawbacks associated with the use of different sources of energy.

The specification content includes a specific requirement to consider issues associated with health and safety and the environment. See section 5.

8.5 THE EUROPEAN DIMENSION

OCR has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen assessments. European examples should be used where appropriate in the delivery of the subject content. Relevant European legislation is identified within the specification where applicable. See Section 5.

9 Key Skills

Key Skills are central to successful employment and underpin future success in learning independently. Whilst they are certificated separately, the Key Skills guidance for this qualification has been designed to support the teaching and learning of the content. Opportunities for developing the generic Key Skills of Communication, Application of Number and Information Technology are indicated through the use of a  symbol in Section 5. The wider Key Skills of Working with Others, Problem Solving and Improving Own Learning and Performance may also be developed through the teaching programmes associated with the specification.

The following matrix indicates where coverage exists within the specifications.

	Communication	Application of Number	IT	Working with Others	Improving Own Learning and Performance	Problem Solving
Level 1	✓	✓	✓	✓	✓	✓
Level 2	✓		✓	✓	✓	✓

Detailed opportunities for generating Key Skills evidence through this specification are posted on the OCR website: www.ocr.org.uk. A summary document for Key Skills coordinators showing ways in which opportunities for Key Skills arise within GCSE courses will be published during 2001.

10 Resources List

OCR will be providing support materials for students and teachers in due course.

11 Arrangements for Candidates with Special Needs

For candidates who are unable to complete the full assessment or whose performance may be adversely affected through no fault of their own, teachers should consult the Inter-Board Regulations and Guidance Booklet for Special Arrangements and Special Consideration.

In such cases, advice should be sought from the OCR Special Requirements team (telephone 01223 552505) as early as possible during the course.

12 Support and In-service Training for Teachers

To support teachers using this specification, OCR will make the following materials and services available:

- a full programme of In-Service training meetings arranged by the Training and Customer Support Division (telephone 01223 552950);
- specimen question papers and mark schemes, available from the Publications department (telephone 0870 8706622, fax 0870 8706621);
- past question papers and mark schemes, available from the Publications department (telephone 0870 8706622, fax 0870 8706621);
- written advice on coursework proposals;
- a report on the examination, compiled by senior examining personnel after each examination session;
- individual feedback to each Centre on the moderation of internally assessed work.

Appendix A: Electrical and Electronic Symbols