Oxford Cambridge and RSA Examinations

RECOGNISING ACHIEVEMENT

OCR GCSE IN DESIGN AND TECHNOLOGY (SYSTEMS AND CONTROL TECHNOLOGY) 1957

Key Features

- Covers National Curriculum Order for Key Stage 4 Design and Technology.
- Options in Electronics, Pneumatics and Mechanisms.
- Coursework clearly linked to teaching content requirement.
- A range of suitable tasks for coursework.
- Immediate support from a specialist subject officer.

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 (SYSTEMS AND CONTROL TECHNOLOGY) 1957

SECTION A: SPECIFICATION SUMMARY

Outline

The revised GCSE specification retains the characteristics of the Design and Technology (Systems and Control Technology) 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 of 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 Systems and Control Technology within an overall design and make based approach. The specification offers a system of assessment for GCSE based on clear targets and a 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="3">Candidates take
Components 2
and 4 or 6 or 8
and 9</td></tr>
<tr><td>A</td></tr>
<tr><td>B</td></tr>
<tr><td>C</td><td rowspan="5">Candidates take
Components 1
and 3 or 5 or 7
and 9</td><td rowspan="5"></td></tr>
<tr><td>D</td></tr>
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COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1 Core (Foundation)	1 hour	20%
2	Paper 2 Core (Higher)	1 hour 15 mins	20%
3	Paper 3 Electronics (Foundation)	1 hour	20%
4	Paper 4 Electronics (Higher)	1 hour 15 mins	20%
5	Paper 5 Pneumatics (Foundation)	1 hour	20%
6	Paper 6 Pneumatics (Higher)	1 hour 15 mins	20%
7	Paper 7 Mechanisms (Foundation)	1 hour	20%
8	Paper 8 Mechanisms (Higher)	1 hour 15 mins	20%
9	Internal Assessment (Coursework)	40 hours	60%

QUESTION PAPERS

Papers 1 and 2 will test a candidate's knowledge and understanding of the core content through questions on designing and making (Section 5, 5.1, 5.2).

Papers 3, 4, 5, 6, 7 and 8 will test a candidate's knowledge and understanding of the chosen option (either Electronics, Pneumatics or Mechanisms) through questions on designing and making (Section 5.3, 5.4 or 5.5). There will be no choice of questions.

Papers will include product analysis questions based on information contained in the question paper.

INTERNAL ASSESSMENT (COURSEWORK)

Internal Assessment (coursework), component 9 will consist of a project where candidates will be expected to design and make a quality Systems and Control Technology product.

The project can be linked to a candidates 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.

Through their project they must consider how technology affects society and their own lives.

ENTRY OPTIONS

All candidates should be entered for 1957 with one of the following option codes:

Option Code	Option	Components
EF	Electronics (Foundation)	1, 3, 9
PF	Pneumatics (Foundation)	1, 5, 9
MF	Mechanisms (Foundation)	1, 7, 9
EH	Electronics (Higher)	2, 4, 9
PH	Pneumatics (Higher)	2, 6, 9
MH	Mechanisms (Higher)	2, 8, 9

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 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 (Systems and Control Technology)

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 OCR GCSE specification with the certification title Design and Technology (Electronic Products) 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 or GNVQ CBE in the same examination series. They may also enter for any Entry Level Certificate or NVQ.

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 9060.

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 1-8 Terminal Examination papers

These will test candidates' specialist knowledge, skills and understanding of Systems and Control Technology through questions on the subject content (section 5) outlined in the specification.

Assessment Component 9 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)

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.

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="4">Candidates take
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</table>

4.2 COMPONENTS

Component	Name	Duration	Weighting
1	Paper 1 Core (Foundation)	1 hour	20%
2	Paper 2 Core (Higher)	1 hour 15 mins	20%
3	Paper 3 Electronics (Foundation)	1 hour	20%
4	Paper 4 Electronics (Higher)	1 hour 15 mins	20%
5	Paper 5 Pneumatics (Foundation)	1 hour	20%
6	Paper 6 Pneumatics (Higher)	1 hour 15 mins	20%
7	Paper 7 Mechanisms (Foundation)	1 hour	20%
8	Paper 8 Mechanisms (Higher)	1 hour 15 mins	20%
9	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 test a candidate's knowledge and understanding of the core content through questions on designing and making (Section 5, 5.1, 5.2). Papers 3, 4, 5, 6, 7 and 8 will test a candidate's knowledge and understanding of the chosen option (either Electronics, Pneumatics or Mechanisms) through questions on designing and making (Section 5.3, 5.4 or 5.5). There will be no choice of questions.

Papers will include product analysis questions based on information contained in the question paper.

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 or 5 or 7	4%	12%	4%	20%
9	12%	36%	12%	60%
Overall	20%	60%	20%	100%

Higher Tier

Component	AO1	AO2	AO3	Total
2	4%	12%	4%	20%
4 or 6 or 8	4%	12%	4%	20%
9	12%	36%	12%	60%
Overall	20%	60%	20%	100%

4.5 ENTRY OPTIONS

All candidates should be entered for 1957 with one of the following option codes:

Option Code	Title	Components
EF	Foundation Tier	Electronics 1, 3, 9
EH	Higher Tier	Electronics 2, 4, 9
PF	Foundation Tier	Pneumatics 1, 5, 9
PH	Higher Tier	Pneumatics 2, 6, 9
MF	Foundation Tier	Mechanisms 1, 7, 9
MH	Higher Tier	Mechanisms 2, 8, 9

4.6 INTERNAL ASSESSMENT (COURSEWORK)

The Internal Assessment will consist of **one** project where candidates will be expected to design and make a quality systems and control technology 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.

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, 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; (1b)	questionnaires, surveys, influences of trends, potential market possibilities
(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;	consideration of existing products past and present
(b) identify and collect data relevant to the product and its users; (1b)	i.e. dimensions, anthropometric data, information from the internet, 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
(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, PS2.2

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, 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
(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 computer simulations, 2D and 3D modelling
(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, electronic and pneumatic 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;	any appropriate change to design proposals and product packaging
(c) determine as a result of modelling, testing or trialling the critical dimensions and tolerances that will determine the method required to manufacture in batch quantity; (2e)	mounting of PCB's, batteries, etc. determine all the details needed to manufacture the product in a batch of 50 using the facilities available
(d) make any necessary modifications;	mounting of switches, valves, gearing, sockets etc.
(e) consider the possibilities and implications for batch production as well as for a prototype;	text, computer images, working drawings, PCB layouts, material/component
(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

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) correct use of marking-out and checking tools; (4a)	try square, calipers, scriber, centre punch, rule, multimeter, pressure gauge
(b) cutting and machining tools;	saws, files, drills etc.
(c) general tools;	screwdrivers, soldering irons, wirecutters, strippers, pliers, spanners
(d) finishing materials;	suitable abrasive papers, finish appropriate to purpose and materials
(e) correct use of tools, equipment and components for shaping, forming, joining, fitting;	matching tools and equipment to the materials and processes, vacuum former
(f) jigs and formers;	repetitive operations i.e. drilling holes
(g) safe working practices.	personal protection and the safety of others
Preparation of drawings	
Candidates should be able to use drafting equipment and/or computer software to achieve a good standard of graphical representation.	access to 2D, 3D CAD software and/or drafting equipment i.e. templates
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 and/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 be able to:	Range of activities
	(4b)
(a) select and use a range of appropriate construction and production methods;	PCB production, soldering, fabrication, component assembly
(b) work with plastics – wasting, fabricating and forming;	injection moulding, vacuum forming, strip bending
(c) work with wood/metal – wasting, shaping and fabricating;	sawing, filing, drilling, and an understanding of machine wasting
(d) select and apply appropriate surface finishes and markings;	labelling, varnish, dip-coat and commercial plating
(e) select and use appropriate adhesives.	PVA, contact, epoxy, tensol cement

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;	i.e. books, videos etc., industrial visits, CD ROMS, internet for data transferral
(b) understand how computer systems can control machines and equipment;	i.e. robotics used in production lines
(c) understand how CAD/CAM is used in the manufacture of single items and small batches. (2d)	modern computer controlled production methods, self adhesive vinyl sign production
Candidates should use ICT where appropriate to:	
(d) desktop publish;	combine written information and graphics, produce a questionnaire
(e) produce bar charts, pie charts etc. from data;	present results in a graphical form
(f) produce graphics;	use a paint or draw program to produce original art work including line, texture, colour
(g) mould and size text, and/or graphics to suit requirements;	produce text in appropriate styles and sizes for presentation
(h) 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 spreadsheet for costing/modelling
(i) utilise CAD; (1g)	generate and manipulate a range of 2D/3D images, producing accurate drawings, PCB masters
(j) utilise CAM.	engravers, lathes, machining centres

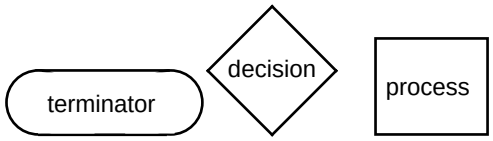
5.1.9 Industrial Applications

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. e.g. using templates and jigs
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 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

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

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
	organise 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;	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, pattern or computer system

5.2 CORE

5.2.1 Materials (4a, 4b, 4c, 4d, 4e)

Candidates should be able to:

- demonstrate a sound working knowledge of materials and composites;
- select materials relative to their characteristics, properties and performance;
- select and use tools, equipment and processes effectively and safely to make products that match a specification;
- recognise common materials and their applications;
- pure and alloyed metals, softwood, hardwood, manufactured boards, thermoforming and thermosetting plastics and composites;
- use 'Smart' and modern materials as they become commercially available i.e. electroluminescent panels, memory metals etc.
- understand that materials deform if subjected to sufficient force and the importance of this when designing: i.e. tensile or hardness testing of materials, tests on glued joints;
- identify and compare the following when selecting materials:

  ductility, plasticity, hardness, malleability, brittleness, toughness, elasticity, conductivity, insulation (thermal and electrical), strength (compression, tension, shear, bending, torsion);

- appreciate that temperature can affect physical properties i.e. rigidity.

Components

Candidates should be able to:

- select and assemble appropriate electronic, pneumatic, mechanical and standard pre-manufactured components (handles, hinges etc.).

Energy

Candidates should be able to:

- understand how different sources of energy can be stored, converted and transmitted to produce a work capacity; primary sources, i.e. solar, wind, water, fossil fuels, nuclear; secondary sources, i.e. batteries, springs, rubber bands, compressed air;
- understand the benefits and drawbacks of different sources of energy, including costs and applications.

5.2.2 Systems and Control (5a)

Electronics

Candidates should be able to:

- use circuit symbols for common components;
- 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;
- design simple circuits in block diagram form, involving appropriate input sensors i.e. light, temperature, moisture, process components and appropriate output devices (lamp, motor, solenoid) for different applications;
- use Ohm's law for simple calculations;
- perform power calculations using P = V x I;
- calculate the resistance of two or more resistors in series using: $R_S = R_1 + R_2 + R_3$;
- understand the action of common switches i.e. toggle switch, push switch, micro-switch, SPST, SPDT, DPDT, NO, NC;
- understand the use of a diode as a one way conductor;
- use LED's in circuits selecting suitable current limiting resistors;
- identify transistor pins from a diagram or data sheet.

Mechanisms and structures

Candidates should be able to:

- build working models and practical devices using resistant materials and kits;
- analyse and describe mechanisms in terms of input, process, output and feedback; recognise the difference between open and closed loop systems;
- recognise both natural and man-made structures as they occur in:
    - plants, trees, honeycombs, webs, animal skeletons;
    - bridges, cranes, pylons, roofs, domestic furniture.
- explain and use in simple calculations the terms: load, effort, fulcrum;
- apply the concept of equilibrium as a result of applied load and reaction;
- explain the practical applications and uses of levers: first, second and third order;
- use the principle of levers to design and make a simple machine;
- sketch simple examples of levers and linkages in use;
- use the unit of force (Newton);
- define a moment as force x distance, use moments in simple calculations (Nm);
- carry out simple calculations of moments of forces applied and exerted by the ends of a lever, i.e. can-crushing machine;
- recognise frames in use and identify the use of triangulation to establish rigidity;

- use different methods of reinforcing such as gussets, ribs, braces, laminating;
- calculate simple gear ratios and transmission speed;
- recognise and give examples of types of motion: rotary, linear, oscillating, reciprocating;
- understand the terms - crank, cam, follower and describe their use in converting linear motion to rotary motion and vice versa.

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:

- checking design proposals against design criteria;
- 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;
- recognising the difference between quality of design and quality of manufacture, and use essential criteria to judge the quality of other people's product.

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 standards 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 mechanical 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 e.g. use of aluminium for ladders, use of lithium in batteries, polyester for capacitors;
- use a range of industrial applications when working with familiar materials and processes;
- how it meets manufacture and maintenance requirements;
- an understanding of a variety of finishing processes and why they are important for aesthetic and functional reasons;
- 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:

(a) As designers and consumers:

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

(b) As workers within the production environment

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

(c) Personal safety:

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

(d) Risk assessment – using information sources:

- COSHH e.g. fumes from 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. air compressor;
- recognition and understanding of safety symbols (UK and European).

(e) 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.

5.3 ELECTRONICS OPTION

5.3.1 Materials and Pre-manufactured Standard Components

Candidates should be able to:

Construction Techniques

- build circuits using a variety of techniques i.e. breadboarding, etching;
- mount components appropriately i.e. on circuit boards and control panels;
- have an awareness of new developments, trends, components and techniques in the electronics industry including 'smart' technology.

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 $P = V \times I$.

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.

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;

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. 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.

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, i.e. 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.

5.3.2 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.

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;
- construct and draw circuits showing the use of an OP-AMP as a comparator.

Timers

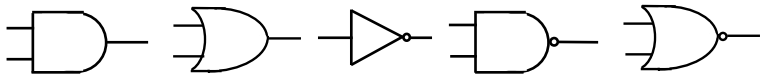
- use an IC to build an astable device for use in counting circuits, i.e. 4011 quad NAND, 555 timer;
- use an IC to provide a monostable circuit i.e. 4528B, 555 timer;
- output the clock pulses to an LED, loudspeaker, transistor or other IC.

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, e.g. Schmitt trigger.

Logic

- explain the functions, AND, OR, NOT, NAND, and NOR 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.

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.

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;
- analyse simple electronic systems and recognise input, process and output circuits i.e. dividing circuits/systems into simpler sub-circuits/systems;
- 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 and vinyl cutter.

5.4 PNEUMATICS OPTION

5.4.1 Materials and Components

Candidates should be familiar with the use of the following components and be able to design and draw appropriate circuit diagrams.

Compressor

- understand the principles of air supply including:

  compressor and reservoir;
  operating pressures;
  safety features.

Single Acting Cylinder

- understand the structure of a single-acting cylinder in relation to its function and be able to use it in practical design applications i.e. pop up toy, fail safe device;
- control a single-acting cylinder using a 3-port valve.

Double Acting Cylinders

- understand the structure of double-acting cylinders in relation to their function and be able to select appropriate types for practical design applications, e.g. reed switch cylinder, non cushioned, buffered, cushioned;
- control a double-acting cylinder with 3-port and 5-port valves.

Controlling Piston Speed

- understand why it is necessary to control piston speed.

Restrictors

- understand the action of a restrictor and use it to achieve control of piston speed in piped circuits i.e. sliding door, clamp.

Bi-directional Uni-directional Restrictors

- understand the structure of bi-directional and uni-directional restrictors in relation to their function and how this affects circuit design e.g. industrial machine tool operations;
- describe industrial examples of piston speed control i.e. control of sliding door speed.

Sensors Feedback Signal

- use special types of 3-port valve and 5-port valve for pilot control and direct control of cylinders i.e. :

lever operated	i.e. on/off control;
pushbutton operated	i.e. emergency stop;
roller trip operated	i.e. automatic reciprocation;
diaphragm	i.e. amplifier circuits;
plunger operated	i.e. automatic depth stop;
foot-pedal operated	i.e. fork lift truck;
key operated	i.e. safety/security systems;
uni-directional roller operated	i.e. machine tool throttling down;
solenoid operated	i.e. electronic/computer controlled system

- understand positional feedback.

Air Bleed Occlusion

- use a diaphragm operated valve in conjunction with low pressure air, bleeding from a small hole i.e. circuit.

Shuttle Valve

- use and understand the operation of a shuttle valve e.g. multi point emergency stops.

5.4.2 Technological Principles

Understand basic pneumatic principles and applications i.e. cycle pump, tyre.

Pneumatics Design

- design and draw appropriate circuit diagrams i.e. using C.E.T.O.P/ISO symbols.

Time Delay

- use a reservoir and uni-directional restrictor to create a time delay;
- understand the limitations of accuracy of pneumatic time delay circuits;
- describe practical applications of pneumatic time delays i.e. safety systems, pressing operations.

Signal Amplification

- understand how an air bleed from a small hole can be used to generate a feedback signal;
- describe practical applications for air bleed circuits i.e. component sensing or counting, press position sensing.

Logic Functions

OR

- use and understand the operation of a shuttle valve to achieve an OR function;
- understand the need for OR functions and design and pipe up circuits for simple examples i.e. operating a sliding door from both sides;

AND

- understand why the AND gate is not considered safe in all applications involving transport;
- understand how to use two 3-port valves to achieve a simple AND function;
- understand the limitations of this type of circuit if used for operator safety when starting a machine;
- design and pipe up simple circuits to achieve an AND function for specified applications;
- describe practical applications for logic functions in pneumatic circuits i.e. safety circuits requiring multi-point operation.

Automatic Reciprocation

- understand the design of a circuit using 3-port trip valves, for positional feedback, to activate an air operated , air reset 5-port valve used as the cylinder directional control valve.

Sequential Control

- understand the design of a sequential control circuit to control cylinders in a stated sequence i.e. automatic drilling, pressing or clamping.

Dual Signal

- understand what is meant by a dual signal and how to overcome it by using a Group Air System. Limited to two group control e.g. industrial machine tool operations.

Magnitude of Linear Motion

- understand the relationship between force (N) and pressure (N/mm²) and cross-sectional area (mm²) of a piston in a pneumatic cylinder, including taking account of different surface areas of a double acting cylinder;
- calculate the magnitude of this force in simple examples and be able to use the results in design situations;
- energy;
- understand the relationship between the pressure (N/mm²) being used in a system and the number of times the unit volume of air has been 'squeezed' by the compressor and the ultimate cost of the fuel to drive the compressor e.g. cost implications to consumer.

5.4.3 Systems and Control

Candidates should be able to:

- understand the concepts of input, process and output and the importance of feedback in controlling systems;
- recognise that pneumatic systems can be controlled by computer and interface devices;
- pipe up and control circuits, including breadboarding and fully constructed models;
- devise pneumatic control systems, integrating them with electronics and mechanisms for the best designed solutions;
- mount components accurately, using commercial mounts where appropriate, to achieve efficient power transmission.

5.5 MECHANISMS OPTION

5.5.1 Mechanisms

Candidates should be able to:

General Concepts

- explain and use in simple calculations the terms: load, effort, fulcrum, mechanical advantage, velocity ratio, efficiency;
- understand and apply Newton's first and third laws of motion.

Transmission of Motion

- describe the types and factors involving the choice of the following gears for practical applications: spur, bevel, helical, worm, contrate, crown wheel, rack and pinion;
- select appropriately and list the factors influencing the choice of the following for practical applications: flat, toothed and vee belts and pulleys, cone pulley, sprockets and chain, splined shafts, universal joints, plain and flexible couplings;
- use standard systems available to maintain the tension in drive belts;
- calculate simple gear ratios and transmission speed;
- calculate driver/driven speeds and determine rotational direction in simple and compound pulley and gear systems;
- determine the Mechanical Advantage (MA), Velocity Ratio (VR), and efficiency of simple machines:
- wheel and axle, screw jack and compound pulley and gear arrangements.

Bearings and Lubrication

- compare and contrast the use of plain, roller and ball bearings, and give reasons for their suitability for specific operational conditions;
- describe the types of lubrication, and the methods of application for different situations.

Conversion of Motion

- recognise and give examples of types of motion:

  rotary, linear, oscillating, reciprocating;
- understand the terms crank, cam, follower, dwell, stroke;
- describe, compare and select appropriately, crankshafts, crank/slider mechanisms, rack and pinion, ratchet and pawl, eccentrics and simple cams as methods of converting linear motion to rotary motion and vice versa.

Control of Motion

- explain the function of brakes, comparing and contrasting the method of operation and effectiveness of hydraulic, disc, drum and cable operated brakes;
- select appropriate applications for each type of brake;
- explain the function of clutches, describing and giving practical applications of single plate clutches, dog clutches and centrifugal clutches.

Energy

- describe the power sources used to drive mechanisms, the energy costs involved and how, through good design and manufacture, the potential energy demand can be reduced.

SECTION D: COURSEWORK

6 Coursework Tasks

6.1 NATURE OF COURSEWORK PROJECT

Candidates are required to produce a systems and control technology product that can be marketed. The underlying influence on the project should 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 positively 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. 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 advice if 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 Gardening is an ever increasingly popular hobby with many gardeners wanting to grow plants from hot and humid parts of the world. These types of plants require a very accurately controlled environment which can only be achieved within a greenhouse.

2 Telescope astronomy requires the operator to constantly re-adjust their telescope position to keep the object being observed in view.

3 A primary school is collecting aluminium drink cans for charity. To reduce storage space it is necessary to crush it flat.

4 A keen gardener wishing to make the most of household waste decides to use teabags on the compost heap. It is found though that the bags require shredding before putting them on the heap. Investigate.

5 A golf club wish to retrieve lost golf ball from a lake. Investigate.

6 The accurate measuring and recording of weather data is important for many jobs and hobbies.

7 With CD's being the most popular means of recording and playing music and games, many people have large collections of CD's.

8 A primary school has a pet hamster which has a habit of escaping.

9 A farmer has noticed that his free-range chickens will all go back to the hen house on their own at dusk. He still has to shut the door each night to secure them from foxes. Investigate.

10 The design and technology department have introduced a recreational course in woodcarving during lunchtimes. Many students have been encountering problems holding their material when carving irregular shapes.

11 The local home for the elderly have indicated that many of their residents have difficulties when they have to open food cans in their own kitchens.

12 A local woodworking company have normally paid to have their wood shavings and/or sawdust removed from their premises at regular intervals. They have now realised that they could sell the waste for fuel if it was in a more compact form.

13 The art department has just invested in some new cameras and developing equipment for its photography course. The developing of photographs requires quite accurate timing.

14 Many keen gardeners make use of their greenhouses throughout the year. This can prove difficult during the winter months with the onset of cold weather.

15 Babies often wake and start crying. Normally if the baby does not need feeding or changing, the parent can gently rock the baby back to sleep.

16 Many cat owners have installed a cat-flap into an exterior door to give the pet freedom to leave and enter the house without disturbing its owner. Investigate the possibilities of a device that will enable the owner to restrict either exit or entrance through the cat-flap at any given time or times.

17 People who are disabled, perhaps only temporarily, are often unable to turn the pages of a book when they are reading. Investigate.

18 Modern garages can often be cramped for space and this can make it difficult to get in and out of the car whilst it is in the garage. To ease the problem the car needs to be parked as close as possible to the nearside wall of the garage giving the driver more space on his side. Investigate.

19 Keeping tropical fish can be a time consuming task. One of the most important tasks is feeding the fish at the same time every day.

20 Mountain bikes are expensive and popular items to own and many are stolen each year. Design and make an alarm device to reduce the cases of theft.

6.3 EXPANSION OF AN 'EXEMPLAR COURSEWORK TASK'

Task 2 - Keeping fish in outdoor ponds is a common pastime. A build-up of algae in the water is a problem that can affect the health of the fish. Investigate.

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

- An analysis of ponds and fish keeping with particular emphasis on the problems of algae build-up in the water.
- A consideration of the range and type of user for such a product.
- A clear statement of the problem and a precise design brief of a marketable product.

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

- An identification of the possible features of the product necessary to accurately detect a dangerous build-up of algae.
- A collection and analysis of information on how existing products solve this problem, or similar problems.
- A collection and analysis of relevant data that may help to solve the problem – sensing equipment, display methods, computer interfacing methods for display of information for example.
- A specification that lists the design requirements of the intended product including the capability for it to be batch produced.

Internal Assessment Objective 3 - Generation of design proposals.

- A collection of annotated sketches showing a range of appropriate solutions. This would include both the method of detecting/displaying algae levels and also any form of packaging.
- Two and/or three-dimensional models are made to help with product development.
- The proposed ideas are evaluated against the specification and good/bad points are identified.
- The best ideas are chosen considering the need and their fitness for purpose.
- The final design proposal is presented using a combination of text, graphical techniques and CAD (computer aided design).

Internal Assessment Objective 4 - Product development.

- An investigation into possible suitable materials including any testing relevant to the intended product purpose. Choice of material is to be based on investigation and testing. This may cover materials for the casing or packaging of the product for example.
- Suitable production methods and the use of pre-manufactured standard components are investigated and recorded using a variety of methods including ICT. Electronic components are typical of pre-manufactured standard parts.
- Modelling and testing to include two and/or three-dimensional models. Computer simulations and tests as well as bench testing. This could involve CAD to provide detailed drawings of the product or part of the product which could be linked to CAM, or using software to design electronic circuits or programmable chip design.
- Modifications to be made following analysis of results which lead to an improved design. Testing may highlight faults with circuit design or with tolerances in assembling component parts.
- The necessary control system is designed to allow for production in batch quantity.
- Full details of materials, production methods and pr-manufactured items required are recorded using a range of graphic techniques and ICT including CAD.

Internal Assessment Objective 5 - Product planning and realisation.

- A plan of action is produced specifying an effective order for manufacture of the product considering materials, tools and equipment.
- The realisation is carried out demonstrating the economic and efficient use of materials, tools and equipment. Modifications may be made during making in response to changes in circumstances. It is a good idea to record these changes.
- A range of skills and techniques are evident along with safe working procedures.
- The product meets the requirements of the design specification.

Internal Assessment Objective 6 - Evaluation and testing.

- The outcome is evaluated against the original specification.
- Its fitness for purpose is tested on the intended user group.
- Proposals for further development are suggested with illustrations to show where improvements could be made.
- The performance of the manufacturing control system is analysed after use and modifications suggested.
- Section D: practical teaching issues.

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 project 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 PROJECT

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 e.g.: OCR GCSE in Design and Technology (Systems and Control Technology) 1957
  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 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 a Systems and Control Technology 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 type of project selected should be challenging, but realistic in terms of resources and time available. Candidates are actively encouraged to think about the needs/requirements of the user group and the situation the product will be used in. It is vital that a design brief is established at the beginning of the process, to enable candidates to focus their research. (Some Centres provide the candidates with a set theme as a starting point, others allow individuals to recognise their own design need/opportunity).

Having established a design brief, candidates need to extend their understanding of the situation by collecting, documenting and analysing relevant data. Candidates should be encouraged to use ICT where appropriate. Digital cameras, scanned and down loaded images, internet and CD-ROM access can all provide opportunities for candidates to document information. Feedback from the intended user group about the requirements and expectations of the product can be obtained via a survey or in-depth interview with an expert. Product analysis of similar products already available can inform opinions about human interaction, product functions, value for money etc. The design specification provides a clear understanding of all the major design requirements needed to make the product successful. The candidate should acknowledge the considerations for quantity production as part of the specification. Quick initial design sketches can be developed and modeled using CAD. Annotation can provide additional details about possible solutions. The final design selection needs to be discussed and justified against the original design specification. Where appropriate, candidates should consider the use of 'smart' and modern materials.

During the product development section, candidates need to develop their idea towards a final product. They test control systems, materials and production methods. The results need to be recorded and decisions justified. Exact sizes and shapes of components are established. Prepared spreadsheets may be used to show the costing for one single item and/or batch of ten etc. ICT can be used to test the design of a system prior to manufacture. 3D modelling tools can create realistic representation of the finished product. Candidates are to design and make a simple device such as a jig, former or template that can be used as part of a system to maintain consistency during the manufacture of their product. The success of this device is assessed during the evaluation report.

Prior to realisation, candidates need to plan the order of manufacture, the processes, tools and equipment to be used. Time plans help to keep the candidate on target. Using a range of skills and techniques, candidates are expected to make a quality product that meets the requirements of the design specification.

The evaluation report provides the opportunity for the candidate to analyse the outcome against the original specification and whether they have used the correct materials, equipment etc. Full product testing will establish the success of the product and consumer/user group opinions will inform suitable modifications and further product development. An evaluation of the system designed to maintain consistency during production would establish its effectiveness and need for further improvements.

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;	One or more solutions proposed. Little or no evaluation. The work displays a low standard of communication techniques.	[1] [1] [1]	**0-3**
• present design solutions using a range of graphic techniques and ICT including computer-aided design (CAD), to generate, develop, model and communicate design proposals.	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: • materials and components; • tools, equipment and processes; • 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. Techniques.	[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 the 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 the 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 Systems and Control Technology.

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 value 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.

This 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.

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 specification.

	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.

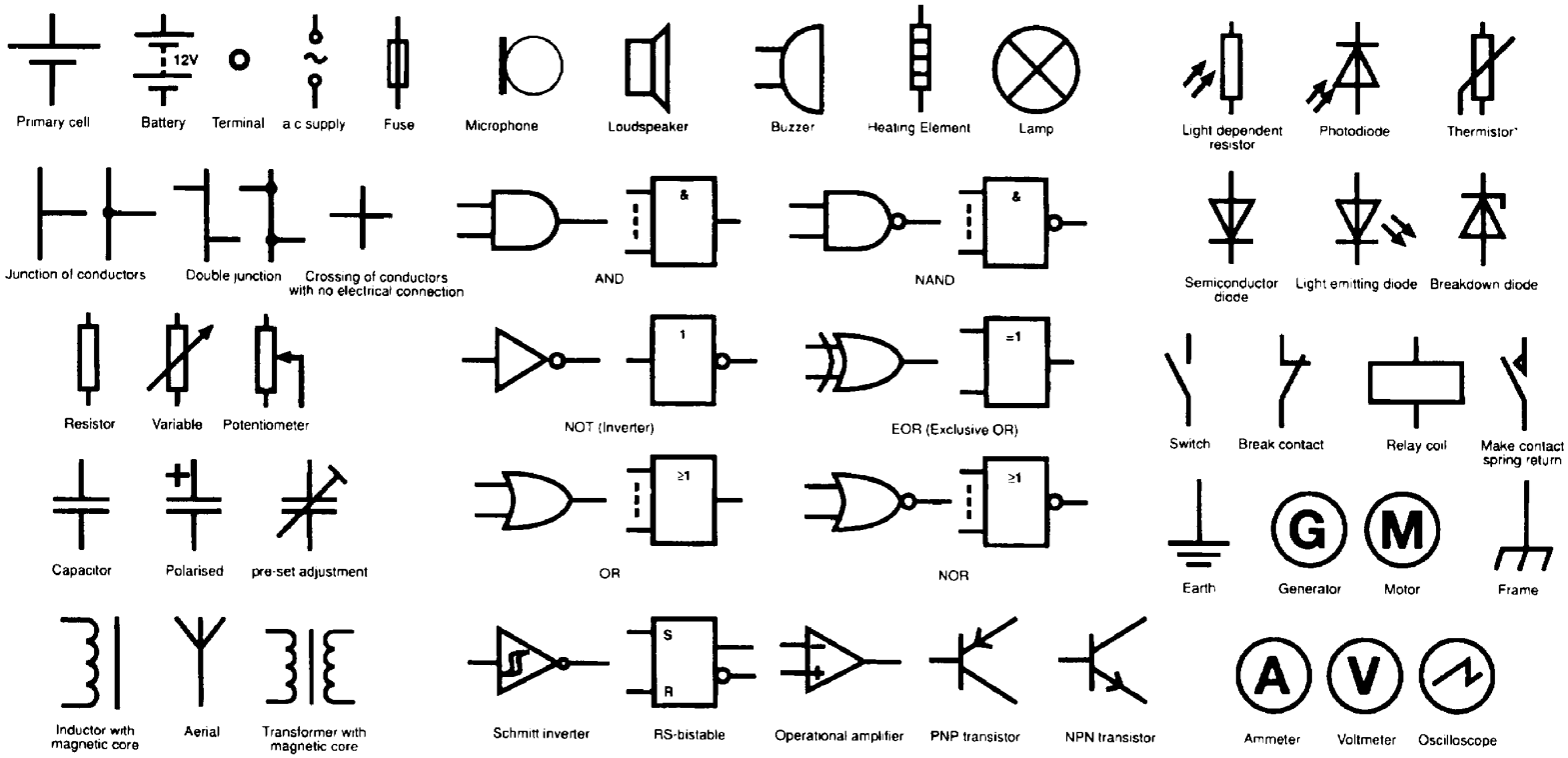
In such cases, advice should be sought from the OCR Special Requirements team (telephone 01223 552505) as early as possible during the course.

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);
- coursework guidance materials;
- examples of marked work;
- 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.

Electrical & Electronic Symbols



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