Design and Technology

GCSE 2012

D&T: Electronics & Control Systems

Specification

J301 – Full Course

Version 1

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OCR GCSE in Design and Technology: Electronics & Control Systems J301

Contents

1 Introduction to GCSE in Design Technology: Electronics and Control Systems

1.1 Introduction to the Innovator Design and Technology Suite

The Innovator Design and Technology suite comprises six Design and Technology GCSEs for the innovators of the future:

- Electronics and Control Systems
- Food Technology
- Graphics
- Industrial Technology
- Resistant Materials
- Textiles Technology

All six specifications follow the same structure:

Unit 1: Introduction to designing and making

- Developing research and investigation skills
- Developing drawing skills where appropriate
- Modelling/Trialling
- Evaluating process/product

Unit 2: Making quality products

- Designing for a need
- Working with tools and equipment
- Making a product
- Evaluating the product

Unit 3: Sustainability and technical aspects of designing and making

- Consideration of products
- Consideration of the environment
- Consideration of society and economy
- Working with tools and materials
- Selecting processes
- Designing for success

These specifications provide an innovative and imaginative suite of qualifications rewarding flair and imagination, and reflecting the contemporary use of materials and information technology. One key element of these specifications is to encourage candidates to recognise the contribution they can make to meeting human needs and the environment through careful consideration and selection of sustainable resources.

Candidates have the opportunity to work with design concepts and materials in ways which recognise the need for wise choices being made in terms of meeting the needs of people, society, and the environment. Taught as a suite of qualifications there are opportunities for efficient use of both human and physical resources. Teachers can be confident in the knowledge that they are part of a team preparing candidates for a common goal.

Candidates wishing to follow a **Short Course in any D&T material area** should take **GCSE Design and Technology Product Design units A551 and A552**, details of which can be found in GCSE Design and Technology Product Design Specification J305.

1.2 Overview of GCSE Design and Technology: Electronics and Control Systems (J301)

Unit A511: ***Introduction to designing and making*** This unit involves candidates researching, designing and subsequently modelling a functional prototype. Candidates must select a theme set by OCR (see Appendix A). This theme can be contextualised in order to suit centre-specific circumstances.	60 marks 30% of the total GCSE marks Controlled assessment – 20 hours This unit is internally assessed and externally moderated.
+	
Unit A513: ***Making quality products*** This unit focuses on the design and manufacture of a complete product from a theme set by OCR (see Appendix A). This should involve the candidate in the identification of a suitable design opportunity, generation of design ideas showing creativity, modelling and skilful manufacture of a quality product recording the key stages/processes of making and critical evaluation.	60 marks 30% of the total GCSE marks Controlled assessment – 20 hours This unit is internally assessed and externally moderated.
+	
Unit A515: ***Sustainability and technical aspects of designing and making.*** This unit focuses on the knowledge, skills and understanding underpinning the design and manufacture of products made using control systems.	80 Marks 40%of the total GCSE marks 1 hour 30mins written paper **Section A** consists of **15** short questions and **one** question which may involve sketching, annotation, short sentences and extended writing. This section will focus on sustainability, product analysis and design. **Section B** consists of **three** questions which may involve sketching, annotation, short sentences and extended writing. This section will focus on the technical aspects of working with equipment and the design of products. This unit is externally assessed.

1.3 Guided learning hours

GCSE Design and Technology: Electronics and Control Systems requires 120–140 guided learning hours in total.

1.4 Aims and learning outcomes

GCSE specifications in Design and Technology should encourage candidates to be inspired, moved and challenged by following a broad, coherent, satisfying and worthwhile course of study and gain an insight into related sectors, such as manufacturing and engineering. They should prepare candidates to make informed decisions about further learning opportunities and career choices.

GCSE specifications in Design and Technology must enable candidates to:

- actively engage in the processes of Design and Technology to develop as effective and independent learners
- make decisions, consider sustainability and combine skills with knowledge and understanding in order to design and make quality products
- explore ways in which aesthetic, technical, economic, environmental, ethical and social dimensions interact to shape designing and making
- analyse existing products and produce practical solutions to needs, wants and opportunities, recognising their impact on the quality of life
- develop decision-making skills through individual and collaborative working
- understand that designing and making reflect and influence cultures and societies, and that products have an impact on lifestyle
- develop skills of creativity and critical analysis through making links between the principles of good design, existing solutions and technological knowledge.

1.5 Prior learning/attainment

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

2.1 Unit A511: *Introduction to designing and making*

This unit focuses on:

- developing research and investigation skills
- developing drawing skills
- modelling
- evaluating process.

This unit aims to give candidates an introduction to designing and making using control systems.

Candidates must select one of the published themes (see Appendix A) as a starting point for this controlled assessment unit. Once a theme is selected, the candidate will need to identify a specific existing product or starting point that is associated with the theme. For example, if the chosen theme is 'Travel' a candidate may decide to design and model a hand-held game which can be used 'on the move'.

Candidates undertake research associated with the specific product before establishing their own design brief and detailed specification for an improved or similarly functioning product. They develop their design and use modelling before making and testing their prototype* and evaluating the making process. Throughout the process, the candidate will record research and design developments using a portfolio to include photographs and other digital media. In the design process, candidates must use the systems approach, clearly showing Input–Process–Output.

In order to skilfully design, model, make and test their prototype*, candidates should undertake the processes outlined overleaf.

This unit is a controlled assessment unit. For further details see Section 4.

**In this context a prototype is defined as the first example of a product that could be further developed or modified.*

Candidates will be assessed on their ability to:		
Demonstrate creativity	•	Use appropriate recording and drawing techniques including the use of ICT.
	•	Identify complex associations linking principles of good design and technological knowledge.
	•	Identify trends in existing products and fully evaluate them against the needs of the intended user.
Demonstrate designing skill	•	Produce an appropriate and considered response to a design brief.
	•	Produce a detailed specification for the product.
	•	Use detailed notes and annotated drawings to record original design ideas.
	•	Use appropriate making or trialling techniques to aid product development.
	•	Use CAD to support design development.
	•	Make reasoned decisions about materials/components.
Demonstrate good making skills	•	Plan and organise activities.
	•	Select appropriate materials/components.
	•	Select appropriate equipment.
	•	Work skilfully and safely to shape, and form finish materials and assemble components.
	•	Complete a quality prototype*.
	•	Apply knowledge of control systems, digital media and new technologies as appropriate.
	•	Demonstrate a practical and thorough understanding and ability in solving technical problems effectively and efficiently as they arrive.
	•	Record key stages in the making of the product.
Demonstrate critical evaluation skills	•	Evaluate the processes involved in making the final prototype*.
	•	Reflect on the evaluation and suggest modifications to improve the making process.

**In this context a prototype is defined as the first example of a product that could be further developed or modified.*

2.2 Unit *A513: Making quality products*

This unit focuses on:

- designing for a need
- working with tools and equipment
- making a product
- evaluating the product.

In this unit candidates will further develop skills and abilities gained while undertaking Unit A511 in order to design and make a fully functioning quality product. Candidates must select one of the published themes (see Appendix A) as a starting point for this controlled assessment unit. The type of project selected needs to be challenging but realistic in terms of the resources and time available. Candidates should be encouraged to consider their own needs/requirements or that of an identified user group as well, as the situation in which the product will be used.

Candidates will be required to consider the focus of the design brief before developing a design specification. Candidates need to demonstrate their ability to plan, to develop creative and original design ideas and to carry out a range of practical activities.

Candidates will critically evaluate their ideas against the design specification to identify, with reasons, the chosen design proposal for product development. As a result of product development candidates will give reasoned decisions for the materials, components and equipment required for the production of the final product. Throughout the task the candidate will record research and design developments using a portfolio to include photographs and other digital media. In the design process candidates must use the systems approach clearly showing Input–Process–Output.

Candidates will test and critically evaluate their final product against a product specification.

This unit is a controlled assessment unit. For further details see Section 4.

Candidates will be assessed on their ability to:	
Develop and demonstrate designing skills	• Use appropriate recording and drawing techniques. • Identify complex associations linking principles of good design and technological knowledge. • Produce an appropriate and considered response to a design brief. • Produce a detailed specification for the product. • Use detailed notes and annotated drawings (where appropriate) to record original design ideas. • Use appropriate modelling or trialling techniques to aid product development. • Use ICT/CAD/CAM to support design development. • Apply knowledge of digital media and new technologies as appropriate. • Use drawing and annotation to communicate clearly details of the design chosen for prototype production.
Demonstrate good making/workshop skills	• Plan, organise and record key manufacturing activities by means of comprehensive notes and photographic evidence. • Make reasoned decisions about materials/components. • Select appropriate materials/components. • Select appropriate tools and equipment. • Work skilfully and safely to shape, form, finish materials and assemble components. • Apply knowledge of production systems, ICT and new technologies as appropriate. • Finish the product to a high-quality standard. • Demonstrate a practical and thorough understanding and ability in solving technical problems effectively and efficiently as they arise.
Demonstrate critical evaluation skills	• Evaluate the product against the specification. • Undertake detailed testing and present meaningful conclusions.

2.3 Unit A515: *Sustainability and technical aspects of designing and making*

This unit focuses on:

- consideration of products
- consideration of the environment
- consideration of society and the economy
- working with tools, materials and components
- selecting processes
- designing for success.

This unit focuses on the knowledge, skills and understanding underpinning the design and manufacture of products made using electronics and control systems.

The assessment of this unit is through an externally set and externally marked test.

Candidates will need a knowledge and understanding of:

- trends and innovations in design manufacture, labelling and packaging
- social, moral, cultural, economic, environmental and sustainability issues inherent in Design and Technology
- product life cycle and life cycle analysis (LCA)
- designing and making quality manufactured products
- planning production with consideration of the use of time and resources
- performance characteristics of different materials, including 'smart' and modern materials the impact of emerging technologies on designers and consumers
- tools and equipment, including new technologies, used to make quality manufactured products
- processes and techniques used to make quality manufactured products that are functional
- health and safety issues.

Candidates will be assessed on their knowledge of:	
The 6Rs	**Recycle** • Materials that can be recycled – primary, secondary, tertiary. • Products that use recycled materials. • Disassembly- reprocessing materials for use in new products.
	Reuse • Products that can be reused for either the same purpose or a new purpose. • Products that can be adapted to suit an alternative use.
	Reduce • Life cycle of product(s)/Eco Footprint. • Built in obsolescence. • Energy and waste of production process. • Materials – waste.
	Refuse • Issues relating to sustainable design. • Materials we should refuse to use.
	Rethink • How it is possible to approach design problems differently. • An existing product that has become waste, e.g. utilising materials or components for another purpose without processing it.
	Repair • Products that can be repaired and consider issues of repair.
Product analysis and the design of products	**Social issues** • Social development, through recognising the need to consider the views of others including people with disabilities when designing and discussing designed products. • Signs and symbols giving valuable information about materials, products and safety issues. • Anthropometrics and ergonomics.
	Moral Issues • Conditions of working. • Protecting the safety of users of products. • Ethical trading initiative (ETI).
	Cultural issues • Looking at, responding to and valuing the responses of others to design solutions. • The impact of different cultures on modern products.

	Environmental issues • Understanding and being able to select materials, including 'smart' and 'modern' materials that are both suitable and sustainable. • The reduction in the common use of chemicals and materials dangerous to the environment, i.e. bleaches, CFCs, toxic materials. • Carbon footprint – transportation of materials and goods, energy usage in manufacture. • Carbon offsetting. • The need to dispose of redundant products and their packaging in a safe and environmentally friendly way.
	Design issues • Identifying how good design and product choice improves the quality of life. • Examining the way that designers respond to changing styles, taste, technological advances and environmental pressures. • Eco-design – the whole system of looking at a product from design to finished article, its use of materials and energy. • The globalisation of products.

Materials for control systems

		Electronics	Mechanisms	Pneumatics
General classification	• Metals and plastics in common use in school workshops and the manufacturing industry.	✓	✓	✓
	• Timber composites and manufactured board.		✓	
	• Availability and selection of appropriate specific materials for particular applications in one-off and quantity production.	✓	✓	✓
	• Market forms of materials; standard shapes and sizes of metal sections; sheet, powder and granular plastics.		✓	

Performance characteristics	•	Properties and applications of metals and alloys – including steel, brass, copper, aluminium alloys.		✓	✓
	•	• Properties and applications of thermoplastics – including ABS, polystyrene, PVC, nylon, acrylic.	✓	✓	✓
	•	Properties and applications of thermosetting plastics – including GRP, PCB substrate, epoxy adhesive.	✓		
	•	Properties and applications of timber composites – including plywood, particle board.			
	•	Properties and applications of timber composites – including plywood, particle board.		✓	
Finishing processes	•	Labelling.	✓		
	•	Protection from the working environment.	✓	✓	✓
	•	Protection from wear in use.		✓	✓
'Smart' and modern materials	•	Including – QTC, memory metals; properties and typical applications.	✓	✓	✓
Properties of materials	•	Physical properties when selecting for a specific use.	✓	✓	✓
	•	Aesthetic qualities of materials.	✓	✓	✓
	•	Cost implications.	✓	✓	✓
Pre-manufactured components	•	Components needed in the manufacture of a product.	✓	✓	✓
	•	Identify and suggest an application for a wide range of pre-manufactured components.	✓	✓	✓
Mechanical properties	•	Tension, compression, torsion, shear, bending.		✓	✓
Structural properties	•	Ductility, plasticity, hardness.		✓	✓
Conductive properties	•	Thermal, electrical.	✓	✓	✓
Health and safety	•	COSHH regulations relating to materials.	✓	✓	✓

Nanotechnology	•	Define nanotechnology as the manipulation of atoms.	✓	✓	✓
Nanomaterials	•	Nanowires, carbon nanotubes as semiconductors; manufacture of transistors and capacitors.	✓	✓	
Health and safety issues	•	Awareness of potential risks, e.g. particles of nanomaterial entering the bloodstream.	✓	✓	✓
Radio Frequency Identification (RFID)	•	Physical characteristics, active and passive devices, operating frequencies, range of readers.	✓	✓	✓
Applications	•	Uses as a replacement for bar codes, stock control, inventories, toll pass cards, clothing.	✓	✓	✓
Printable circuits	•	Printing circuits using inkjet technology, printable transistors using carbon nanotubes; comparison to traditional subtractive circuit production methods.	✓		
Design of products	•	Generate and record a range of innovative design solutions for a specific task/user need.			
	•	Evaluate and modify ideas with consideration of creativity and sustainability.			
	•	Consider the initial task, the need to be met, function and aesthetics.			
	•	Develop and model design proposals.			
	•	Justify choice and rejection of ideas.			
	•	Select and justify materials when designing and making products.			
	•	Use a range of skills to communicate ideas including graphic techniques, ICT including CAD and digital technologies.			
	•	Understand the purpose of prototyping when designing and making products.			
	•	Identify a variety of methods used when prototyping, including breadboard, CAD simulation, use of systems approach.			
	•	Understand the principles of anthropometrics and ergonomics when designing and making products.			
	•	Identify specific ergonomic requirements within a product and apply anthropometric data when designing and making products.			

Product planning	•	Produce a detailed plan for making that includes information on: - materials and manufactured items - tools and equipment - processes - health and safety - time schedules.
	•	Choose and prepare materials economically, considering cost.
	•	Plan work to make best use of materials, components, equipment and resources, including time and energy.
	•	Be aware of problems that arise during production and have strategies to overcome them.
Tools and equipment	•	Knowledge and understanding of the basic equipment for Control Systems; how to select the appropriate tool and use it safely and effectively.
	•	Awareness of alternative tools and equipment which can be used for the same task.
	•	Care and maintenance of tools and equipment.
	•	Safe use of hand and machine tools.
	•	Safety checks to carry out on electrical equipment before use.
	•	Checks before use including correct settings on machines such as lathes, milling machines and pillar drills.

Processes	
Process and skills	Understand a range of processes used to make control systems in the school workshop and manufacturing industry. In addition, candidates should be able to name tools and equipment appropriate to these processes, including: • preparing, marking out, measuring and testing; using a rule, try square, callipers, dividers, scriber, punches and electronic measuring instruments – digital vernier/micrometer/multimeter • additional processes: adhesives – PVA, epoxy resin, tensol; brazing; threading; use of nuts/bolts/screws, pop rivet • wasting; using hand-cutting tools for metal, wood, plastics, electronics; sawing, filing, planing, drilling, fine finishing, abrasives • the use of jigs, fixtures, templates and patterns to aid quantity production • using machine tools: drill, lathe, milling machine, router; CNC tools: lathe, milling machine, router, vinyl cutter • forming processes – vacuum forming, line bending • assembly tools: screwdriver, soldering iron, wire cutters, wire strippers, spanners, pliers • finishing processes – self-finishing and applied surface finishes for protection and decoration, including polishing, painting, plating, plastic coating • process planning – stages involved in carrying out processes accurately and effectively; application of flow charts, block diagrams and tables to show sequence of operations.
Computer applications	• Use CAD packages in the school environment for producing drawings and 2D/3D images. • Use on-screen modelling and manipulation of images. • Use text, database and graphics software appropriately in school and commercial situations. • Apply CAD/CAM to the designing and making of models and prototypes. • Apply CAD/CAM to one-off and quantity production. • Computer control machines (CNC) including lathes, milling machines, routers, machining centres, laser cutters, robots.

2

The areas in the following sections are optional. Candidates are only expected to study **one** area from electronics, mechanisms or pneumatics.

Electronics

- Components – selection, mounting and fixing of components, cable selection and use.
- Power sources – battery, solar, capacitor, mains adaptor.
- Discrete components – resistor, capacitor, diode, transistor, relay.
- Sensors – for light, heat, sound, pressure.
- ICs – voltage regulator, logic, PIC, op-amp, timer, drivers, logic family.
- Switches/relays – types, configurations, applications.
- Modular components – e, speech synthesiser, amplifier, LCD unit.
- Circuit design – breadboard, CAD simulation, use of systems approach.
- Circuit manufacture – PCB manufacture.
- Input circuits – voltage regulation, sensors, e.g. LDR, thermistor, microphone, PIR, potential divider.
- Processing circuits – PIC circuits, monostable, bistable, astable, transistor circuits, comparator.
- Counters – clock circuit, binary counters, decade counters.
- Logic – (AND, OR, NAND, NOR, NOT, XOR) application of logic gates singly and in combination.
- Output circuits – LED 7 segment display, LCD display, drivers for relay, motor, solenoid, speaker.
- Calculations – units of voltage, current, power, ohms law, potential divider.
- Construction techniques – soldering, connecting between boards, ribbon cable/connecting plugs and sockets, PCB to case fittings.
- Quality control – testing, fault identification, reworking.

Mechanisms

- General terms – load, effort, fulcrum, mechanical advantage, efficiency.
- Components – gears, motors, pulleys, belts, chains, fixings e.g. nuts, bolts, washers, rivets.
- Modular components – gearbox, modelling systems.
- Levers – orders of lever and applications.
- Types of motion – rotary, linear, oscillating, reciprocating.
- Conversion of motion – crank, cam.
- Transmission of motion:
  - gearing systems: spur, bevel, helical, worm, rack and pinion, belt and pulley, sprocket and chain
  - drive systems: splined shaft, plain and flexible couplings, tensioning drive belts and chains
  - bearings and lubrication: types of bearing and materials used, lubrication systems
  - control of motion: brakes, clutches
  - motors, stepper motors, actuators.
- Power sources – energy costs, conservation of energy.
- Calculations – driver / driven speeds, rotational direction, mechanical advantage, velocity ratio.

Pneumatics

Materials and components		
Candidates should be familiar with the use of the following components and be able to design and draw appropriate circuit diagrams:		
Air supply	•	Compressor and reservoir/receiver, safety valve, regulator, pressure gauge, drain valve, operating pressures; safety features.
Cylinders	•	Single acting, double acting, cushioned, non–cushioned, reed switch.
Valves	•	3/2 (3 port 2 way), 5/2, shuttle.
Valve control	•	Pushbutton, lever, plunger, foot pedal, roller trip, uni-directional roller, key, diaphragm, solenoid.
Restrictors (FCV)	•	Bi-directional, uni-directional.
Circuits	•	Air bleed occlusion, time delay, pressure decay sensing, automatic reciprocation, sequential control, signal amplification.
Logic functions	•	OR using a shuttle valve, AND using 2 valves, NOT using an invert circuit.
Group air system	•	Used to avoid a dual signal in sequential control.
Calculations	•	Calculate the force (N), piston diameter, cross-sectional area (mm^2), pressure (N/mm^2) using $F = PxA$ $A = \pi r2$ in simple examples and be able to use the results in a design situation.
Systems and control		
Flowcharts	•	Design a flowchart for a control sequence; use inputs, outputs, process, feedback.
Computer/ microcontroller	•	Design and understand pneumatic circuits controlled by computer/ microcontroller, PICs, inputs from reed switched cylinders, outputs to solenoid valves, limit switches.
Integrating pneumatics	•	Integrating pneumatics with electronics and mechanisms.
Design	•	Design solutions for mounting and connecting components; design for making; design for safe application; problem solving and theoretical design for sustainability.
Vacuum principles	•	Vacuum cups used for lifting or holding work.
Hydraulics	•	Simple water circuits, syringes.
Modelling with air or water	•	Using syringes to model circuits with air or water.
Safety	•	Safety legislation for pneumatics; care when using compressed air and piping-up circuits, use of safety valves.

Generic content for all three areas:	
Quality	
	• Distinguish between quality of design and quality of manufacture. • Show how the quality of a product may be affected by materials and processes used in its manufacture. • Understand the importance of dimensional accuracy in component parts for assembly. • Describe simple quality-control checks to ensure accuracy and quality of finish.
Health and safety	
	• Understand the importance of personal safety when engaged in designing and making activities, including: - personal protective equipment - machine guards - accident procedures. • Understand basic risk-assessment procedures. • Understand COSHH in the context of workshop and studio activities. • Understand the importance of following instructions provided for certain materials and processes. • Be able to identify design modifications needed to make products safer to use.
Product evaluation	
	• Establish the function of control systems; determine what the product or system was designed to do. • Identify the materials and components from which products or systems are made; give reasons why specific materials have been used by referring to the working properties of materials. • Identify the process used to make the product or system. • Compare a variety of commercially manufactured products and systems designed to meet the same need. • Test their own and commercially manufactured products and systems to determine fitness for purpose and identify improvements to the design, materials and processes used, with reference to technical efficiency and innovation.

Delivery of the Unit

In this unit, candidates could develop their knowledge and understanding through:

- focused practical tasks that develop a range of technical skills and knowledge of sustainability, materials and processes
- product analysis
- design-and-make assignments that include activities relating to industrial practices
- group discussion, videos, industrial visits. Research could involve the internet, interviews, questionnaires, experimental work.

Candidates should have the opportunity to develop a wide range of practical skills.

Evidence should be collected and recorded in the form of a research report (not assessed), which can be used at the end of the unit for examination preparation.

Assessment of GCSE Design and Technology: Electronics and Control Systems

3

3.1 Assessment in GCSE Design and Technology: Electronics and Control Systems

For GCSE Design and Technology: Electronics and Control Systems candidates must take all **three** units.

Unit A511: *Introduction to designing and making*

30% of the total GCSE

Controlled assessment

Approx 20 hours

60 marks

Quality of written communication is assessed in this unit (see Section 3.5).

The task will require the candidate to produce:

- a number of concise worksheets (A3, A4 or digital equivalent) showing design development modelling, and evaluation including annotations of materials, machinery and working practices used. This may include the use of ICT to support the designing process
- a design specification
- a prototype product that can be evaluated
- digital images/photographs of any models or mock-ups used by the candidate when designing, modelling, testing or evaluating to exemplify key stages, materials and techniques used
- digital images/photographs showing sufficient detail of the prototype in use and the quality of the finished prototype
- a completed OCR cover sheet.

Tasks will be conducted under informal supervision within tight guidelines specified by OCR (see Section 4).

Teachers are required to ensure that candidates do not pursue the same theme for their work as submitted or intended for submission for unit A513.

In addition to the formal 20 hours there should also be further teaching time to increase depth and knowledge and understanding before starting the controlled assessment.

The task must allow the candidate to:

- develop and use research and investigation skills
- develop drawing skills
- use modelling
- produce a prototype
- evaluate the process.

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

It is not expected that the prototype product should accompany the portfolio during the external moderation process.

This controlled assessment is marked internally and externally moderated.

Unit A513: *Making quality products*

30% of the total GCSE

Controlled assessment

Approx 20 hours

60 marks

Quality of written communication is assessed in this unit (see Section 3.5).

The task will require the candidate to produce:

- a production plan including a design specification
- a number of concise worksheets (A3, A4 or digital equivalent) showing design development, modelling, testing and evaluation including annotations of materials, machinery and working practices used. This may include the use of CAD to support the designing process
- a product that can be evaluated
- digital images/photographs of any models or mock-ups used by the candidate when designing, modelling, testing or evaluating to exemplify key stages, materials and techniques used
- two digital images/photographs showing sufficient detail of the final product in use and the quality of the final product
- a completed OCR cover sheet.

Tasks will be conducted under informal supervision within tight guidelines specified by OCR (see Section 4).

Teachers are required to ensure that candidates do not pursue the same theme for their work as submitted or intended for submission for unit A511.

In addition to the formal 20 hours there should also be further teaching time to increase depth and knowledge and understanding before starting the controlled assessment.

The task will allow the candidate to:

- design for a need
- work with tools and equipment
- make a product
- evaluate the product.

Candidates must use appropriate ICT to help with their work, including CAD/CAM, control programs, data analysis, and ICT-based sources for research and design relevant to the task.

It is not expected that the final product should accompany the portfolio during the external moderation process.

This controlled assessment is marked internally and externally moderated.

Unit A515: *Sustainability and technical aspects of designing and making*	
40% of the total GCSE 1hour 30 mins written paper 80 marks Quality of written communication is assessed in this unit (see Section 3.5).	There will be **three** question papers, one each for electronics, mechanisms and pneumatics. Candidates will choose **one** paper, corresponding to their chosen subject. Each paper will contain **two** sections. Section A will be generic across the three papers; Section B will be unique to the chosen subject. The papers will consist of questions that focus on sustainability and technical aspects of designing and making. **Section A** consists of **15** short questions and **one** question which may involve sketching, annotation, short sentences and extended writing. This section will focus on sustainability, product analysis and design. **Section B** consists of **three** questions which may involve sketching, annotation, short sentences and extended writing. This section will focus on the technical aspects of working with equipment and the design of products. This unit is externally assessed.

3.2 Assessment Objectives (AOs)

Candidates are expected to demonstrate their ability to:

AO1	Recall, select and communicate their knowledge and understanding in Design and Technology including its wider effects.
AO2	Apply knowledge, understanding and skills in a variety of contexts and in designing and making products.
AO3	Analyse and evaluate products, including their design and production.

3.2.1 AO weightings – GCSE Design and Technology: Electronics and Control Systems

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

Unit	% of GCSE			Total
	AO1	AO2	AO3	
Unit A511: *Introduction to designing and making*	8	18	4	30%
Unit A513: *Making quality products*	0	25	5	30%
Unit A515: *Sustainability and technical aspects of designing and making*	26	7	7	40%
Total	34%	50%	16%	100%

For GCSE Design and Technology: Electronics and Control Systems candidates must take all three units.

3.3 Grading and awarding grades

GCSE results are awarded on the scale A* to G. Units are awarded a* to g. Grades are indicated on certificates. However, results for candidates who fail to achieve the minimum grade (G or g) will be recorded as *unclassified* (U or u) and this is **not** certificated.

Most GCSEs are unitised schemes. When working out candidates' overall grades OCR needs to be able to compare performance on the same unit in different series when different grade boundaries may have been set, and between different units. OCR uses a Uniform Mark Scale to enable this to be done.

A candidate's uniform mark for each unit is calculated from the candidate's raw mark on that unit. The raw mark boundary marks are converted to the equivalent uniform mark boundary. Marks between grade boundaries are converted on a pro rata basis.

When unit results are issued, the candidate's unit grade and uniform mark are given. The uniform mark is shown out of the maximum uniform mark for the unit, e.g. 40/60.

The specification is graded on a Uniform Mark Scale. The uniform mark thresholds for each of the assessments are shown below:

(GCSE) Unit Weighting	Maximum Unit Uniform Mark	Unit Grade								
		a*	a	b	c	d	e	f	g	u
30%	60	54	48	42	36	30	24	18	12	0
40%	80	72	64	56	48	40	32	24	16	0

A candidate's uniform marks for each unit are aggregated and grades for the specification are generated on the following scale:

Qualification	Max Uniform Mark	Qualification Grade								
		A*	A	B	C	D	E	F	G	U
GCSE	200	180	160	140	120	100	80	60	40	0

The written paper will have a total weighting of 40% and controlled assessment a weighting of 60%.

A candidate's uniform mark for the paper will be combined with the uniform marks for the controlled assessments to give a total uniform mark for the specification. The candidate's grade will be determined by the total uniform mark.

3.4 Grade descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; 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 assessment objectives overall. Shortcomings in some aspects of the assessment may be balanced by better performance in others.

The grade descriptors have been produced by the regulatory authorities in collaboration with the awarding bodies.

3.4.1 Grade F

Candidates recall, select and communicate knowledge and understanding of basic aspects of Design and Technology, including its wider effects.

They apply limited knowledge, understanding and skills to plan and carry out simple investigations and tasks, with an awareness of the need for safety and precision. They modify their approach in the light of progress.

They review their evidence and draw basic conclusions.

3.4.2 Grade C

Candidates recall, select and communicate sound knowledge and understanding of Design and Technology, including its wider effects.

They apply knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks. They test their solutions, working safely and with precision.

They review the evidence available, analysing and evaluating some information clearly, and with some accuracy. They make judgements and draw appropriate conclusions.

3.4.3 Grade A

Candidates recall, select and communicate detailed knowledge and thorough understanding of Design and Technology, including its wider effects.

They apply relevant knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks effectively. They test their solutions, working safely and with a high degree of precision.

They analyse and evaluate the evidence available, reviewing and adapting their methods when necessary. They present information clearly and accurately, making reasoned judgements and presenting substantiated conclusions.

3.5 Quality of written communication

Quality of written communication is assessed in all units.

Candidates are expected to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
- use technical language as appropriate
- present information in a form that suits its purpose
- use an appropriate style of writing and, where applicable, specialist terminology.

4 Controlled assessment in GCSE Design and Technology: Electronics and Control Systems

This section provides general guidance on controlled assessment: what controlled assessment tasks are, when and how they are available; how to plan and manage controlled assessment and what controls must be applied throughout the process. More support can be found on the OCR website.

Teaching and Learning

Controlled assessment is designed to be an integral part of teaching and learning. Activities which develop skills take place regularly in the workshop/studio, using a variety of appropriate resources (as chosen by the teacher). These opportunities will allow candidates to practise a wide range of tasks, which teachers can discuss with them and comment on their performance as appropriate. There are no restrictions regarding time or feedback to individual candidates.

When all necessary teaching and learning has taken place and teachers feel that candidates are ready for assessment, candidates can be given the/should choose an appropriate controlled assessment task.

4.1 Controlled assessment tasks

All controlled assessment tasks for units A511 and A513 are set by OCR. (See appendix A)

Controlled assessment tasks will be available on Interchange and will be reviewed every two years. Guidance on how to access controlled assessment tasks from Interchange is available on the OCR website.

Centres must ensure that candidates undertake a task applicable to the correct year of the examination.

Centres can choose one from a number of theme based tasks offered by OCR (see Appendix A). These tasks can be used with a minimum amount of adaptation or they can be adapted so that they allow the usage of local resources available to any centre. These tasks may also be set within overarching scenarios and briefs more relevant to centres' own environment and targeted at their particular cohorts of candidates.

Each controlled assessment theme (see Appendix A) includes a number of starting points which indicate the type and degree of contextualisation that is allowed. Controlled assessment themes **must not** be changed by centres. When contextualising starting points centres must be careful not to make changes which could put at risk the opportunity for candidates to meet the assessment criteria, including the chance to gain marks at the highest level.

The same OCR controlled assessment task must NOT be used as practice material and then as the actual live assessment material. Centres should devise their own practice material using the OCR specimen controlled assessment materials as guidance.

Teachers **can:**

- explain the task
- advise on how the task could be approached
- advise on resources
- alert the candidate to key things that must be included in the final piece of work.

Teachers **must not:**

- comment on or correct the work
- practise the task with the candidates
- provide templates, model answers or feedback on drafts.

4.2 Planning and managing controlled assessment

Controlled assessment tasks are available at an early stage to allow planning time. It is anticipated that candidates will spend a total of about 20 hours in producing the work for unit A511 and about 20 hours in producing the work for unit A513. Candidates should be allowed sufficient time to complete the tasks.

Suggested steps are included below, with guidance on regulatory controls at each step of the process. Teachers must ensure that the control requirements indicated below are met throughout the process.

4.2.1 Preparation and research time

Preparation (informal supervision)

Informal supervision ensures that the work of the individual candidates is recorded accurately and that plagiarism does not take place. Assessable outcomes may be informed by group work, but must be an individual response.

- Introduction to the task (teacher led) **1 hour**

Includes choice of tasks, possible approaches and sources of evidence, time allocations, programmes of work and deadlines, methods of working, control requirements.

Research (limited supervision)

Limited supervision means that candidates can undertake this part of the process without direct teacher supervision and outside the centre as required. Candidates are also able to work in collaboration during this stage. However, when producing their final piece of work, candidates must complete and/or evidence all work individually.

During the research phase candidates can be given support and guidance.

Research material can include fieldwork, internet or paper-based research, questionnaires, audio and video files etc. Candidates must be guided on the use of information from other sources to ensure that confidentiality and intellectual property rights are maintained at all times. It is essential that any material directly used from a source is appropriately and rigorously referenced.

4.2.2 Producing the final piece of work (formal supervision)

Formal supervision means under direct teacher supervision: the teacher must be able to authenticate the work and insist on acknowledgement and referencing of any sources used. Writing up is likely to be carried out over several sessions. Work must be collected and kept secure between sessions.

When supervising tasks, teachers are expected to:

- exercise continuing supervision of work in order to monitor progress and to prevent plagiarism
- exercise continuing supervision of practical work to ensure essential compliance with Health and Safety requirements
- ensure that the work is completed in accordance with the specification requirements and can be assessed in accordance with the specified marking criteria and procedures.

Candidates must work independently to produce their own final piece of work.

4.2.3 Presentation of the final piece of work

Candidates must observe the following procedures when producing their final piece of work for the controlled assessment tasks:

- tables, graphs and spreadsheets may be produced using appropriate ICT. These should be inserted into the report at the appropriate place
- any copied material must be suitably acknowledged
- quotations must be clearly marked and a reference provided wherever possible
- work submitted for moderation or marking must include a completed coversheet giving the following information:
  - centre number
  - centre name
  - candidate number
  - candidate name
  - unit code and title
  - assignment title.

Work submitted in digital format (CD or online) for moderation or marking must be in a suitable file structure as detailed in (Appendix B) at the end of this specification. Work submitted on paper must be secured by treasury tags or other suitable methods.

4.3 Marking and moderating controlled assessment

All controlled assessment units are marked by the centre assessor(s) using OCR marking criteria and guidance and are moderated by the OCR-appointed moderator. External moderation is either e-moderation where evidence is online or postal moderation.

4.3.1 Applying the marking criteria

The starting point for marking the tasks is the marking criteria (see section 4.3.4 *Marking criteria for controlled assessments* tasks). The criteria identify levels of performance for the skills, knowledge and understanding that the candidate is required to demonstrate. Before the start of the course, and for use at INSET training events, OCR provides exemplification through real or simulated candidate work which will help to clarify the level of achievement the assessors should be looking for when awarding marks.

4.3.2 Use of 'best fit' approach to marking criteria

The assessment task(s) for each unit should be marked by teachers according to the given marking criteria within the relevant unit using a 'best fit' approach. For each of the assessment criteria, teachers select one of the three band descriptors provided in the marking grid that most closely describes the quality of the work being marked.

Marking should be positive, rewarding achievement rather than penalising failure or omissions. The award of marks **must be** directly related to the marking criteria.

Teachers use their professional judgement in selecting the band descriptor that best describes the work of the candidate.

To select the most appropriate mark within the band descriptor, teachers should use the following guidance:

- where the candidate's work *convincingly* meets the statement, the highest mark should be awarded
- where the candidate's work *adequately* meets the statement, the most appropriate mark in the middle range should be awarded
- where the candidate's work *just* meets the statement, the lowest mark should be awarded.

Teachers should use the full range of marks available to them and award *full* marks in any band for work which fully meets that descriptor. This is work which is 'the best one could expect from candidates working at that level'. Where there are only two marks within a band the choice will be between work which, in most respects, meets the statement and work which just meets the statement. For wider mark bands the marks on either side of the middle mark(s) for 'adequately met' should be used where the standard is lower or higher than 'adequate' but **not** the highest or lowest mark in the band.

Only one mark per assessment criteria will be entered. The final mark for the candidate for the controlled assessment unit is out of a total of 60 and is found by totalling the marks for each of the marking criteria strands.

There should be clear evidence that work has been attempted and some work produced. If a candidate submits no work for the internally assessed units, then the candidate should be indicated as being absent from that unit. If a candidate completes any work at all for an internally assessed unit, then the work should be assessed according to the marking criteria and the appropriate mark awarded, which may be zero.

4.3.3 Annotation of candidates' work

Each piece of internally assessed work should show how the marks have been awarded in relation to the marking criteria.

The writing of comments on candidates' work, and coversheet, provides a means of communication between teachers during the internal standardisation and with the moderator if the work forms part of the moderation sample.

4.3.4 Marking criteria for controlled assessment tasks

Marking criteria for controlled assessment: Unit A511		
0 marks = no response or no response worthy of credit		
Unit A511: CREATIVITY		
Basic ability	**Sound ability**	**High ability**
• Identifies basic links between principles of good design and technological knowledge. • Identifies basic trends in existing solutions and uses this limited understanding in a design context using appropriate techniques.	• Identifies sound links between principles of good design and technological knowledge. • Identifies and demonstrates the significance of trends in existing solutions; interprets and applies this understanding in a design context using appropriate techniques.	• Identifies complex links between principles of good design and technological knowledge. (AO1) • Identifies and demonstrates a thorough understanding of the significance of trends in existing solutions; reinterpret and applies this understanding in imaginative ways using appropriate techniques. (AO1)
[1– 3]	**[4 – 7]**	**[8 – 10]**
Unit A511: DESIGNING		
Basic ability	**Sound ability**	**High ability**
• Provides a limited response to a brief and produces a basic specification for a prototype product. • Produces basic design ideas and communicates these by using a limited range of strategies.	• Provides an appropriate response to a brief and produces a sound specification for a prototype product. • Produces a sound range of creative design ideas and communicates these by using appropriate strategies.	• Demonstrates an appropriate, detailed and considered response to a brief and produces a thorough specification for a prototype product. (AO2) • Produces a comprehensive range of creative, original and developed design ideas and communicates these using appropriate strategies. (AO2)
[1 – 4]	**[5 – 10]**	**[11 – 14]**

Unit A511: MAKING		
Basic ability	**Sound ability**	**High ability**
• Plans and organises basic activities. • Selects and uses components and materials that are not always appropriate. • Selects and uses hand and machine tools that are not always appropriate. • Works safely but with limited competence to assemble, construct and finish materials and components to generate a prototype. • Uses workshop/design studio facilities as instructed to realise the prototype product.	• Plans and organises sound activities. • Selects and uses components and materials that are mostly appropriate. • Selects and uses hand and machine tools that are mostly appropriate. • Works safely, effectively and with sound level of competence to assemble, construct and finish materials and components to achieve a good quality prototype product. • Selects and uses workshop/design studio facilities that are mostly appropriate to realise the prototype product.	• Plans and organises complex activities. • Selects and uses components and materials that are consistently appropriate. • Selects and uses hand and machine tools that are consistently appropriate. • Works consistently safely, skilfully and with competently to assemble, construct and finish materials and components to achieve a high quality prototype product. (AO2) • Consistently selects and uses workshop/design studio facilities appropriately to realise the prototype product. (AO1/AO2)
[1 – 6]	**[7 – 13]**	**[14 – 20]**
• Demonstrates limited and practical understanding and ability in solving a technical problem as it arises.	• Demonstrates a sound practical understanding and ability in solving technical problems as they arise.	• Demonstrate a thorough practical understanding and ability in solving technical problems effectively and efficiently as they arise. (AO2)
[1]	**[2 – 3]**	**[4]**
• Records the making of the prototype by providing limited notes and photographic evidence.	• Records key stages involved in the making of the prototype product by providing sound notes and photographic evidence.	• Records key stages involved in the making of the prototype product; by providing comprehensive notes and photographic evidence. (AO2)
[1]	**[2 – 3]**	**[4]**

Unit A511: CRITICAL EVALUATION		
Basic ability	**Sound ability**	**High ability**
• Basic evaluation of the modelling and prototyping process.	• Sound evaluation of the making process which reflects on how to improve the modelling and prototyping process.	• Critical evaluation of the processes involved in designing and making the prototype which reflects and suggests modifications to improve the modelling and prototyping process. (AO3)
• Limited use of specialist terms.	• Some use of specialist terms, although these may not always be used appropriately.	• Specialist terms will be consistently used appropriately and correctly.
• Answers may be ambiguous or disorganised.	• Information presented for the most part in a structured format.	• Information consistently presented in a structured format.
• Errors of spelling, punctuation and grammar may be intrusive	• Occasional errors in spelling, punctuation and grammar that do not impede communication.	• Consistently accurate use of spelling, punctuation and grammar.
[1 – 2]	**[3 - 5]**	**[6 – 8]**

Marking Criteria for Controlled Assessment: Unit A513		
0 marks = no response or no response worthy of credit		
Unit A513: DESIGNING		
Basic ability	**Sound ability**	**High ability**
• Provides a limited response to a brief and produces a basic specification for a product.	• Provides an appropriate response to a brief and produces a sound specification for a product as a result of analysis.	• Provides an appropriate, detailed and considered response to a brief and produces a detailed specification for a product as a result of analysis. (AO2)
[1]	**[2-3]**	**[4]**
• Produces basic design ideas and communicates these by using a limited range of strategies including ICT.	• Produces a sound range of creative design ideas and communicates these by using a range of strategies including ICT.	• Produces a wide range of creative, original and developed design ideas and communicates these by using a range of strategies including ICT. (AO2)
[1-5]	**[6-8]**	**[9-12]**

Unit A513: MAKING		
Basic ability	**Sound ability**	**High ability**
• Plans and organises basic activities. • Selects and uses materials that are not always appropriate. • Selects and uses equipment that is not always appropriate to the material area. • Works safely but with limited competence to shape, form, assemble and finish materials or components as appropriate to achieve a product. • Uses workshop facilities as appropriate to the material area. • The product is of a low quality of outcome and may not be successfully completed.	• Plans and organises sound activities. • Selects and uses materials that are mostly appropriate. • Selects and uses equipment that is mostly appropriate to the material area. • Usually works safely, effectively and with a sound level of competence to shape, form, assemble and finish materials or components as appropriate to achieve a good quality product. • Usually selects and uses workshop facilities as appropriate to the material area. • The product is completed to a good quality and meets most of the requirements of the final product specification.	• Plans and organises complex activities. • Selects and uses materials that are consistently appropriate. • Selects and uses equipment that is consistently appropriate to the material area. (AO2) • Works consistently safely, skilfully and competently to shape, form, assemble and finish materials or components as appropriate to achieve a high quality product. (AO2) • Consistently selects and uses workshop facilities as appropriate to the material area. (AO2) • The product is completed to a high standard and fully meets the requirements of the final product specification. (AO2)
[1-9]	**[10-17]**	**[18-24]**
• Demonstrates a limited practical understanding of how to solve technical problems as they arise.	• Demonstrates a sound practical understanding and ability in solving some technical problems as they arise.	• Demonstrates a thorough practical understanding and ability in solving technical problems effectively and efficiently as they arise. (AO2/AO3)
[1-2]	**[3-4]**	**[5-6]**
• Records the making of the product by providing limited notes and photographic evidence.	• Records key stages involved in the making of the product by providing sound notes and photographic evidence.	• Records key stages involved in the making of the product by providing comprehensive notes and photographic evidence. (AO2)
[1-2]	**[3-4]**	**[5-6]**

Unit A513: CRITICAL EVALUATION		
Basic ability	**Sound ability**	**High ability**
• Basic evaluation of the finished product with limited reference to the specification.	• Sound evaluation of the finished product with appropriate reference to the specification.	• Critical evaluation of the finished product against the specification. (AO3)
• Undertakes limited testing of the product in use with limited reflection on how to improve the product.	• Undertakes some testing and usually reflects on how to improve the product.	• Undertakes detailed testing and presents meaningful conclusions leading to proposals for modifications to improve the product. (AO3)
• Limited use of specialist terms.	• Some use of specialist terms, although these may not always be used appropriately.	• Specialist terms consistently used appropriately and correctly.
• Answers may be ambiguous or disorganised.	• Information presented for the most part in a structured format.	• Information consistently presented in a structured format.
• Errors of spelling, punctuation and grammar may be intrusive.	• Occasional errors in spelling, punctuation and grammar that do not impede communication..	• Consistently accurate use of spelling, punctuation and grammar.
[1 – 2]	**[3 - 5]**	**[6 – 8]**

4.3.5 Authentication of work

Teachers must be confident that the work they mark is the candidate's own. This does not mean that a candidate must be supervised throughout the completion of all work but the teacher must exercise sufficient supervision, or introduce sufficient checks, to be in a position to judge the authenticity of the candidate's work.

Wherever possible, the teacher should discuss work-in-progress with candidates. This will not only ensure that work is underway in a planned and timely manner but will also provide opportunities for assessors to check authenticity of the work and provide general feedback.

Candidates must not plagiarise. Plagiarism is the submission of another's work as one's own and/or failure to acknowledge the source correctly. Plagiarism is considered to be malpractice and could lead to the candidate being disqualified. Plagiarism sometimes occurs innocently when candidates are unaware of the need to reference or acknowledge their sources. It is therefore important that centres ensure that candidates understand that the work they submit must be their own and that they understand the meaning of plagiarism and what penalties may be applied. Candidates may refer to research, quotations or evidence but they must list their sources. The rewards from acknowledging sources, and the credit they will gain from doing so, should be emphasised to candidates as well as the potential risks of failing to acknowledge such material. Candidates may be asked to sign a declaration to this effect. Centres should reinforce this message to ensure candidates understand what is expected of them.

Please note: Centres must confirm to OCR that the evidence produced by candidates is authentic. The Centre Authentication Form includes a declaration for assessors to sign and is available from the OCR website and OCR Interchange.

4.3.6 Internal standardisation

It is important that all internal assessors, working in the same subject area, work to common standards. Centres must ensure that the internal standardisation of marks across assessors and teaching groups takes place using an appropriate procedure.

This can be done in a number of ways. In the first year, reference material and OCR training meetings will provide a basis for centres' own standardisation. In subsequent years, this, or centres' own archive material, may be used. Centres are advised to hold preliminary meetings of staff involved to compare standards through cross-marking a small sample of work. After most marking has been completed, a further meeting at which work is exchanged and discussed will enable final adjustments to be made.

4.3.7 Moderation

All work for controlled assessment is marked by the teacher and internally standardised by the centre. Marks are then submitted to OCR, after which moderation takes place in accordance with OCR procedures: refer to the OCR website for submission dates of the marks to OCR. The purpose of moderation is to ensure that the standard of the award of marks for work is the same for each centre and that each teacher has applied the standards appropriately across the range of candidates within the centre.

Each candidate's work should have a cover sheet attached to it with a summary of the marks awarded for the task in relation to the marking criteria defined in Section 4.3.4. If the work is to be submitted in digital format, this cover sheet should also be submitted electronically within each candidate's files.

4.4 Submitting the moderation samples via the OCR Repository

The OCR Repository is a secure website for centres to upload candidate work and for assessors to access this work digitally. Centres can use the OCR Repository for uploading marked candidate work for moderation.

Centres can access the OCR Repository via OCR Interchange, find their candidate entries in their area of the Repository, and use the Repository to upload files (singly or in bulk) for access by their moderator.

The OCR Repository allows candidates to send evidence in electronic file types that would normally be difficult to submit through postal moderation; for example multimedia or other interactive unit submissions.

There are three ways to load files to the OCR Repository:

1 Centres can load multiple files against multiple candidates by clicking on 'Upload candidate files' in the Candidates tab of the Candidate Overview screen.

2 Centres can load multiple files against a specific candidate by clicking on 'Upload files' in the Candidate Details screen.

3 Centres can load multiple administration files by clicking on 'Upload admin files' in the Administration tab of the Candidate Overview screen.

The OCR Repository is seen as a faster, greener and more convenient means of providing work for assessment. It is part of a wider programme bringing digital technology to the assessment process, the aim of which is to provide simpler and easier administration for centres.

Instructions for how to upload files to OCR using the OCR Repository can be found on OCR Interchange.

The OCR GCSE Design and Technology: Electronics and Control Systems units A511 and A513 can be submitted electronically to the OCR Repository via Interchange. Please check Section 7.4.1 for unit entry codes for the OCR Repository.

Support for GCSE Design and Technology: Electronics and Control Systems

5

5.1 Free resources available from the OCR website

The following materials will be available on the OCR website:

- GCSE Design and Technology: Electronics and Control Systems Specification
- specimen assessment materials for each unit
- Guide to controlled assessment
- Teachers Handbook
- sample schemes of work and lesson plans.

5.2 Other resources

OCR offers centres a wealth of high quality published support with a choice of 'Official Publisher Partner' and 'Approved Publication' resources, all endorsed by OCR for use with OCR specifications.

5.2.1 Publisher partners

OCR works in close collaboration with publisher partners to ensure you have access to:

- published support materials available when you need them, tailored to OCR specifications
- high quality resources produced in consultation with OCR subject teams, which are linked to OCR's teacher support materials.

Official Publisher Partnership

Hodder Education is the publisher partner for OCR GCSE Design and Technology: Electronics and Control Systems.

Hodder Education produces the following resources for OCR GCSE Design and Technology: Electronics and Control Systems:

- OCR Design and Technology for GCSE: Electronics & Control Systems Teacher Resource DVD-ROM by Chris Walker ISBN: 9780340991206

- OCR Design and Technology for GCSE: Electronics & Control Systems Student Book by Terry Bream, John Drury ISBN: 9780340982013

5.2.2 Endorsed publications

OCR endorses a range of publisher materials to provide quality support for centres delivering its qualifications. You can be confident that materials branded with OCR's 'Official Publishing Partner' or 'Approved publication' logos have undergone a thorough quality assurance process to achieve endorsement. All responsibility for the content of the publisher's materials rests with the publisher.

These endorsements do not mean that the materials are the only suitable resources available or necessary to achieve an OCR qualification.

5.3 Training

OCR will offer a range of support activities for all practitioners throughout the lifetime of the qualification to ensure they have the relevant knowledge and skills to deliver the qualification.

Please see Event Booker for further information.

5.4 OCR support services

5.4.1 Active Results

Active Results is available to all centres offering OCR's GCSE Design and Technology: Electronics and Control Systems specification.

activeresults

Active Results is a free results analysis service to help teachers review the performance of individual candidates or whole schools.

Data can be analysed using filters on several categories such as gender and other demographic information, as well as providing breakdowns of results by question and topic.

Active Results allows you to look in greater detail at your results:

- richer and more granular data will be made available to centres including question level data available from e-marking
- you can identify the strengths and weaknesses of individual candidates and your centre's cohort as a whole
- our systems have been developed in close consultation with teachers so that the technology delivers what you need.

Further information on Active Results can be found on the OCR website.

5.4.2 OCR Interchange

OCR Interchange has been developed to help you to carry out day-to-day administration functions online, quickly and easily. The site allows you to register and enter candidates online. In addition, you can gain immediate and free access to candidate information at your convenience sign up on the OCR website.

6 Equality and Inclusion in GCSE Design and Technology: Electronics and Control Systems

6.1 Equality Act information relating to GCSE Design and Technology: Electronics and Control Systems

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The revised GCSE qualification and subject criteria were reviewed by the regulators in order to identify whether any of the competences required by the subject presented a potential barrier to any disabled candidates. If this was the case, the situation was reviewed again to ensure that such competences were included only where essential to the subject. The findings of this process were discussed with disability groups and with disabled people.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments and to demonstrate what they know and can do. For this reason, very few candidates will have a complete barrier to the assessment. Information on reasonable adjustments is found in *Access Arrangements, Reasonable Adjustments and Special Consideration* by the Joint Council www.jcq.org.uk.

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

The access arrangements permissible for use in this specification are in line with Ofqual's GCSE subject criteria equalities review and are as follows:

	Yes/No	Type of Assessment
Readers	Y	All written examinations
Scribes	Y	All written examinations
Practical assistants	Y	Practical assessments
Word processors	Y	All written examinations
Transcripts	Y	All written examinations
Oral language modifiers	Y	All written examinations
BSL signers	Y	All written examinations
Modified question papers	Y	All written examinations
Extra time	Y	All written examinations

We do not foresee any part of the assessment forming a barrier to any student. There are Design and Technology endorsements which will pose barriers for some disabled candidates.

Candidates with a physical disability may be limited in the range of designing and making contexts they can use, but this should not pose a barrier to assessment.

For example, candidates may use CAD/CAM for the making process and practical assistants may be used to support students with physical disabilities in this process.

Candidates with a visual impairment may find elements of the assessment difficult, such as Graphics; however, there should be no barriers to assessment.

It is important to note that where access arrangements are permitted, they must not be used in a way that undermines the integrity of the assessment. For example, practical assistants can be used to help learners set up but cannot help perform skills which are assessed, such as the ability to physically manipulate equipment.

6.2 Arrangements for candidates with particular requirements (including Special Consideration)

All candidates with a demonstrable need may be eligible for access arrangements to enable them to show what they know and can do. The criteria for eligibility for access arrangements can be found in the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration*.

Candidates who have been fully prepared for the assessment but who have been affected by adverse circumstances beyond their control at the time of the examination may be eligible for special consideration. As above, centres should consult the JCQ document *Access Arrangements, Reasonable Adjustments and Special Consideration*.

7 Administration of GCSE Design and Technology: Electronics and Control Systems

In December 2011 the GCSE qualification criteria were changed by Ofqual. As a result, all GCSE qualifications have been updated to comply with the new regulations.

The most significant change for all GCSE qualifications is that, from 2014, unitised specifications must require that 100% of the assessment is terminal.

Please note that there are no changes to the terminal rule and re-sit rules for the January 2013 and June 2013 examination series:

- at least 40% of the assessment must be taken in the examination series in which the qualification is certificated
- candidates may re-sit each unit once before certification, i.e. each candidate can have two attempts at a unit before certification.

For full information on the assessment availability and rules that apply in the January 2013 and June 2013 examination series, please refer to the previous version of this specification

GCSE Design and Technology: Electronics and Control Systems July 2009 available on the website.

The sections below explain in more detail the rules that apply from the June 2014 examination series onwards.

7.1 Availability of assessment from 2014

There is one examination series available each year in June (all units are available each year in June).

GCSE Design and Technology: Electronics and Control Systems certification is available in June 2014 and each June thereafter.

	Unit A511	Unit A513	Unit A515	Certification availability
June 2014	✓	✓	✓	✓
June 2015	✓	✓	✓	✓

7.2 Certification rules

For GCSE Design and Technology: Electronics and Control Systems from June 2014 onwards, a 100% terminal rule applies. Candidates must enter for all their units in the series in which the qualification is certificated.

7.3 Rules for re-taking a qualification

Candidates may enter for the qualification an unlimited number of times.

Where a candidate re-takes a qualification, **all** units must be re-entered and all externally assessed units must be re-taken in the same series as the qualification is re-certificated. The new results for these units will be used to calculate the new qualification grade. Any results previously achieved cannot be re-used.

For each of the controlled assessment units, candidates who are re-taking a qualification can choose either to re-take that controlled assessment unit or to carry forward the result for that unit that was used towards the previous certification of the same qualification.

- Where a candidate decides to re-take the controlled assessment, the new result will be the one used to calculate the new qualification grade. Any results previously achieved cannot be re-used.
- Where a candidate decides to carry forward a result for controlled assessment, they must be entered for the controlled assessment unit in the re-take series using the entry code for the carry forward option (see section 7.4).

7.4 Making entries

7.4.1 Unit entries

Centres must be approved to offer OCR qualifications before they can make any entries, including estimated entries. It is recommended that centres apply to OCR to become an approved centre well in advance of making their first entries. Centres must have made an entry for a unit in order for OCR to supply the appropriate forms and administrative materials.

It is essential that correct unit entry codes are used when making unit entries.

For the controlled assessment units, centres can decide whether they want to submit candidates' work for moderation through the OCR Repository or by post. Candidates submitting controlled assessment must be entered for the appropriate unit entry code from the table overleaf. Candidates who are re-taking the qualification and who want to carry forward the controlled assessment should be entered using the unit entry code for the carry forward option.

Centres should note that controlled assessment tasks can still be completed at a time which is appropriate to the centre/candidate. However, where tasks change from year to year, centres would have to ensure that candidates had completed the correct task(s) for the year of entry.

Unit entry code	Component code	Assessment method	Unit titles
A511A	01	Moderated via OCR Repository	*Introduction to designing and making - Control Systems*
A511B	02	Moderated via postal moderation	*Introduction to designing and making - Control Systems*
A511C	80	Carried forward	*Introduction to designing and making - Control Systems*
A513A	01	Moderated via OCR Repository	*Making quality products - Control Systems*
A513B	02	Moderated via postal moderation	*Making quality products - Control Systems*
A513C	80	Carried forward	*Making quality products - Control Systems*
A515/A	01	Electronics written paper	*Sustainability and technical aspects of designing and making - Control Systems*
A515/B	02	Pneumatics written paper	
A515/C	03	Mechanisms written paper	

7.4.2 Certification entries

Candidates must be entered for qualification certification separately from unit assessment(s). If a certification entry is **not** made, no overall grade can be awarded.

Centres must enter candidates for:

- GCSE Design and Technology: Electronics and Control Systems certification code J301

7.5 Enquiries about results

Under certain circumstances, a centre may wish to query the result issued to one or more candidates. Enquiries about results for GCSE units must be made immediately following the series in which the relevant unit was taken and by the relevant enquiries about results deadline for that series.

Please refer to the JCQ Post-Results Services booklet and the OCR *Admin Guide: 14–19 Qualifications* for further guidance on enquiries about results and deadlines. Copies of the latest versions of these documents can be obtained from the OCR website at www.ocr.org.uk.

7.6 Prohibited qualifications and classification code

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 9010 and 9060.

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.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should seek advice, either from their centre or from the institution to which they wish to progress.

Other information about GCSE Design and Technology: Electronics and Control Systems

8

8.1 Overlap with other qualifications

There is no significant overlap between the content of these specifications and that for other GCSE qualifications.

8.2 Progression from this qualification

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

Progression to further study from GCSE will depend upon the number and nature of the grades achieved. Broadly, candidates who are awarded mainly Grades D to G at GCSE could either strengthen their base through further study of qualifications at Level 1 within the National Qualifications Framework or could proceed to Level 2. Candidates who are awarded mainly Grades A* to C at GCSE would be well prepared for study at Level 3 within the National Qualifications Framework.

Candidates may progress to GCE in Design and Technology or the Principal Learning in Engineering.

8.3 Avoidance of bias

OCR has taken great care in preparation of this specification and assessment materials to avoid bias of any kind. Special focus is given to the 9 strands of the Equality Act with the aim of ensuring both direct and indirect discrimination is avoided.

8.4 Regulatory requirements

This specification complies in all respects with the current: *General Conditions of Recognition; GCSE, GCE, Principal Learning and Project Code of Practice; GCSE Controlled Assessment regulations and the GCSE subject criteria for GCSE Design and Technology*. All documents are available on the Ofqual website.

8.5 Language

This specification and associated assessment materials are in English only. Only answers written in English will be assessed.

8.6 Spiritual, moral, ethical, social, legislative, economic and cultural issues

These specifications offer opportunities which can contribute to an understanding of these issues in the following topics:

- imaginative and creative activity in their own practical controlled assessment, and develop an appreciation of the imagination and creativity of others in design technology
- moral, cultural, economic, environmental and sustainability issues inherent in design and technology
- moral implications of some applications of technological activities
- the relationship between cultures and societies, the influence they have on designing and making, and that the impact products have on lifestyle
- the role of technology in the context of national and European citizenship.

There are no direct references to spiritual issues within these specifications. However, opportunities may exist to explore this area through the designing and making of products that relate to a religious or spiritual context.

8.7 Sustainable development, health and safety considerations and European developments, consistent with international agreements

This specification supports these issues, consistent with current EU agreements, as outlined below:

- design and technology activities are global and not solely restricted to Europe. Design and making responses are multicultural and arise from identifiable needs and opportunities. These specifications do not make specific reference to European Developments; however, it may be drawn into the course of study in many ways, e.g. European Safety Standards
- encourage candidates to look at emerging and existing technologies in other European countries and the world
- ways in which economic, environmental, ethical and social dimensions interact to influence designing and making
- encourage candidates to consider health and safety when working with tools, equipment, components and materials
- encourage candidates to consider sustainability in making decisions and combining skills with knowledge and understanding in order to design and make quality products.

8.8 Key Skills

This specification provides opportunities for the development of the Key Skills of *Communication, Application of Number, Information and Communication Technology, Working with Others, Improving Own Learning and Performance* and *Problem Solving* at Levels 1 and/or 2. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted for each unit.

The following table indicates where opportunities may exist for at least some coverage of the various Key Skills criteria at Levels 1 and/or 2 for each unit.

Unit	C		AoN		ICT		WwO		IoLP		PS	
	1	2	1	2	1	2	1	2	1	2	1	2
A511	✓	✓			✓	✓	✓		✓	✓	✓	✓
A513	✓	✓			✓	✓			✓	✓	✓	✓
A515	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓

8.9 ICT

In order to play a full part in modern society, candidates need to be confident and effective users of ICT. This specification provides candidates with a wide range of appropriate opportunities to use ICT in order to further their study of Design and Technology: Electronics and Control Systems.

Opportunities for ICT include:

- gathering information from the World Wide Web and CD-ROMs
- gathering data using sensors linked to data-loggers or directly to computers
- using spreadsheets and other software to process data
- using animations and simulations to visualise scientific ideas
- using software to present ideas and information on paper and on screen.

8.10 Citizenship

From September 2002, the National Curriculum for England at Key Stage 4 includes a mandatory programme of study for Citizenship.

There are opportunities for developing knowledge, skills and understanding of citizenship issues particularly in units A511 and A513.

Appendix A: Controlled Assessment Themes Units A511 and Unit A513

Unit A511

The task for this unit is for the candidate to produce a prototype product, capable of being evaluated, and a concise portfolio of work to support the designing and modelling process

Candidates **must** select one of the following themes as a starting point for the task.

Centres are permitted to contextualise the theme and starting point appropriately to reflect centre or community resources, and access to local business and industry that may add realism to the candidates' work.

Teachers are required to ensure that candidates do not pursue the same 'theme' for their work as submitted or intended for submission for unit A513.

Teachers must mark the task using the marking criteria provided in section 4.3.4 (unit A511) of this specification.

In order to design and make their prototype product skilfully, candidates should refer to the content of unit A515 and use designing, planning, making, materials, tools, equipment and process as appropriate.

Theme	Starting point
Model vehicles	Drive systems, chassis and steering, electronic control. Separate systems within the vehicle can be assigned to individual team members.
Animated charity boxes	Providing dynamic visual/audible feedback to the user when money is inserted.
Animated movement	Mechanical models which climb, swim or walk; they can also be used in competitions.
Travel	Games and entertainment for use during travel.
'Flash from trash'	Scrap-heap challenge, re-use materials to revive and refresh a product from another era. Could also be used with vehicles or mechanical movement.
Sport	Timing devices, count down and data collection to improve personal or team performance.
Security	Personal security devices, locking devices, alarms.
Weather	Recording temperature, sunlight, rainfall, detecting black-ice , providing greenhouse information.
Music	Musical instruments, tuning devices.
Numbers	Improving and developing board game, random number generator, counting devices.
Holding devices	Clamping materials when using power tools.
Test rigs	Testing wear in a mechanism e.g. drawer runners.
Transport of goods	Conveyor control systems, sorting systems, moving heavy loads.

Unit A513

The task for this unit is for the candidate to design and manufacture a product. The starting point for this task **must** be selected from a theme set by OCR and listed below.

Centres are permitted to contextualise the theme and starting point appropriately to reflect centre or community resources, and access to local business and industry that may add realism to the candidates' work.

The task can be linked to a candidate's interest or such other influences as competitions, commerce or the community.

Selection of an appropriate theme for the task will be made by candidate and centre, taking account of constraints relating to resources and time available for completion of the task.

Teachers are required to ensure that candidates do not pursue the same 'theme' for their work as submitted or intended for submission for unit A511.

Teachers must mark the task using the marking criteria provided in section 4.3.4 (unit A513) of this specification.

In order to skilfully design and make their product, candidates should refer to the content of unit A515 and use designing, planning, making, materials, tools, equipment and process as appropriate.

Theme	Starting point
Timers	A variable timer to be used with games of skill where each competitor must have a set time (the output must clearly indicate the end of the time period).
Alarms	An alarm to warn of tampering with a sports bag, personal security alarm. (A suitable trigger is required; discrete components or a PIC chip could be used).
4 x 4 Competition vehicle	This multi-part project offers opportunities for teamwork with a number of separate tasks. Tasks could involve mechanisms, control systems or electronics.
Robotics competition	Movement robots can be a combination of electronics and mechanisms and pneumatics and could involve small teams.
Animated movement	Animated figures are a point of interest, mechanical and pneumatic models which climb, walk or swim, can also be used in a competition.
Charity boxes	Opportunities for mechanisms and electronics. The control system is the main part, various inputs and outputs are possible.
Sustainability	How 'appropriate technology' solutions can be applied in developing countries for moving loads/lifting loads.
Environment	How people react with the area they live in. Needs and problems for living. Encouraging responsible use of resources.
Music	Musical instruments, tuning devices.
Games and puzzles	For developing skills or for amusement.
Lighting	For entertainment or soothing effects, sound to light, light 'motion'.
Overcoming disability	Systems and devices to assist the user with a particular disability.
Batch production	Equipment to assist with achieving consistent quality in production.

B Appendix B: Guidance for the production of electronic controlled assessment

Structure for evidence

A controlled assessment portfolio is a collection of folders and files containing the candidate's evidence. Folders should be organised in a structured way so that the evidence can be accessed easily by a teacher or moderator. This structure is commonly known as a folder tree. It would be helpful if the location of particular evidence is made clear by naming each file and folder appropriately and by use of an index called 'Home Page'.

There should be a top level folder detailing the candidate's centre number, candidate number, surname and forename, together with the code A511 or A513, so that the portfolio is clearly identified as the work of one candidate.

Each candidate produces an assignment for controlled assessment. The evidence should be contained within a separate folder within the portfolio. This folder may contain separate files.

Each candidate's controlled assessment portfolio should be stored in a secure area on the centre's network. Prior to submitting the controlled assessment portfolio to OCR, the centre should add a folder to the folder tree containing controlled assessment and summary forms.

Data formats for evidence

In order to minimise software and hardware compatibility issues it will be necessary to save candidates' work using an appropriate file format.

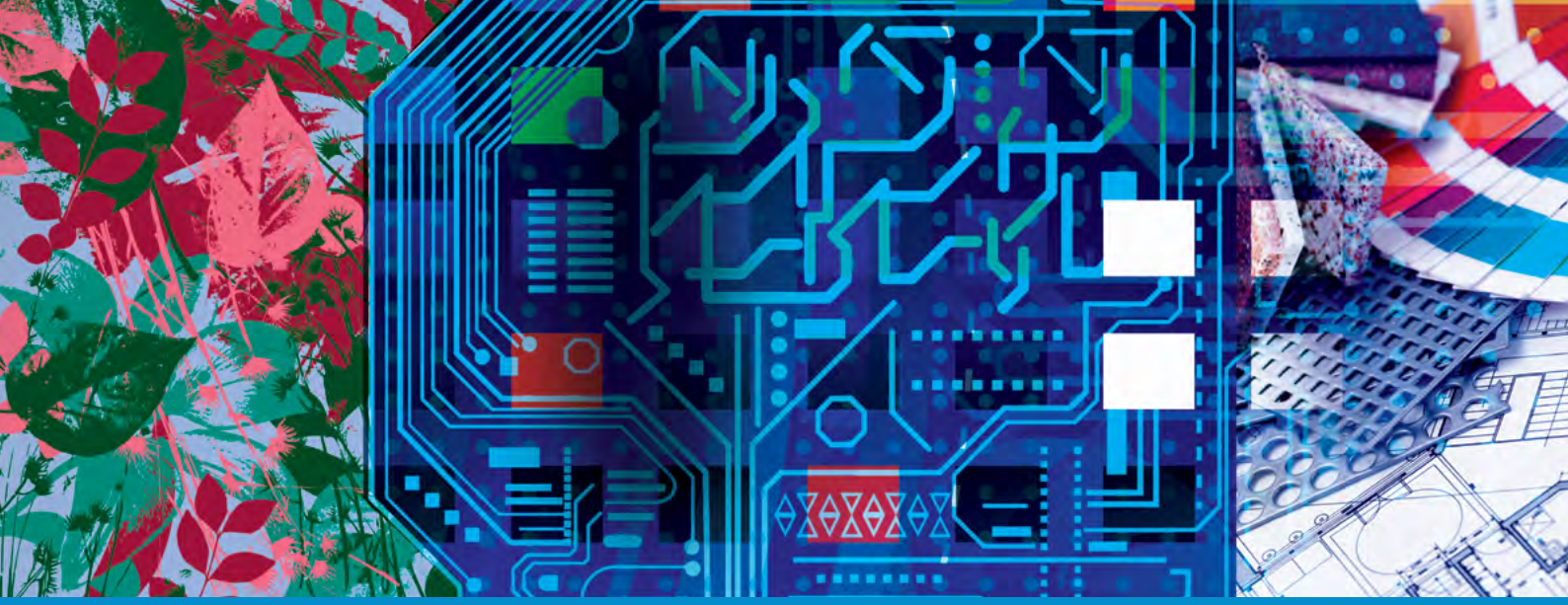
Candidates must use formats appropriate to the evidence that they are providing and appropriate to viewing for assessment and moderation. Open file formats or proprietary formats for which a downloadable reader or player is available are acceptable. Where this is not available, the file format is not acceptable.

Electronic controlled assessment is designed to give candidates an opportunity to demonstrate what they know, understand and can do using current technology. Candidates do not gain marks for using more sophisticated formats or for using a range of formats. A candidate who chooses to use only word documents will not be disadvantaged by that choice.

Evidence submitted is likely to be in the form of word processed documents, PowerPoint presentations, digital photos and digital video.

To ensure compatibility, all files submitted must be in the formats listed below. Where new formats become available that might be acceptable, OCR will provide further guidance. OCR advises against changing the file format that the document was originally created in. It is the centre's responsibility to ensure that the electronic portfolios submitted for moderation are accessible to the moderator and fully represent the evidence available for each candidate.

Accepted File Formats
Movie formats for digital video evidence
MPEG (*.mpg)
QuickTime movie (*.mov)
Macromedia Shockwave (*.aam)
Macromedia Shockwave (*.dcr)
Flash (*.swf)
Windows Media File (*.wmf)
MPEG Video Layer 4 (*.mp4)
Audio or sound formats
MPEG Audio Layer 3 (*.mp3)
Graphics formats including photographic evidence
JPEG (*.jpg)
Graphics file (*.pcx)
MS bitmap (*.bmp)
GIF images (*.gif)
Animation formats
Macromedia Flash (*.fla)
Structured markup formats
XML (*xml)
Text formats
Comma Separated Values (.csv)
PDF (.pdf)
Rich text format (.rtf)
Text document (.txt)
Microsoft Office suite
PowerPoint (.ppt)
Word (.doc)
Excel (.xls)
Visio (.vsd)
Project (.mpp)



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- ✓ Book your inset training place online at **www.ocreventbooker.org.uk**
- ✓ Learn more about active results at **www.ocr.org.uk/activeresults**
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Fax: **01223 552627**

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