Key Stage 4
GCSE D&T

Systems and Control

The Course

Scheme of Work

Systems and Control
Contents

Key Elements of the Systems and Control Course

The GCSE Systems and Control course builds on the Key Stage 3 programme of study for Design and Technology. The course also allows for progression to post 16 courses such as: AS/2 level Product Design or related subjects such as GNVQ Advanced Manufacturing/AVCE Engineering.
The 2 year course allows pupils to gain subject knowledge of Systems and Control (with a focus on mechanisms), design and making skills, and ICT, particularly CAD/CAM skills using a wide range of different materials and manufacturing techniques to produce several outcomes throughout the course culminating in the production of a final coursework project consisting of a 3-dimensional product/s and a concise design folder.

1. Coursework will consist of approximately 40 hours of work by each student producing approximately 20, A4 sheets of work.
2. Pupils will take 2 written papesr at the end of the course (Full Course) testing 'Core' knowledge, and that of the 'Mechanisms' option.

Coursework - 60% of total marks
Written Paper - 40% of total marks

Products should be designed to meet a commercial need. This will include an element of 'control' and some mechanical interface.

Most commercial products are constructed or assembled using a variety of materials. Single material products are acceptable outcomes for this course but it is likely that other materials will have been used to create manufacturing aids such as moulds, jigs, formers etc

The notion of designing products that can be manufactured in batches rather than a one-off product is an important aspect of the course.

A significant amount of time will be given to addressing general manufacturing issues, environmental and social issues as detailed in the course specification.

Summary of Subject Content (Taken from Specification)

The assessment objectives are designed to reflect the programme of study for Design and Technology.
Within this specification candidates will need to demonstrate their ability to:

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

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

- AO1 Capability through acquiring and applying knowledge, skills and understanding of materials components, processes, techniques and industrial practice;
- AO2 Capability through acquiring and applying knowledge, skills and understanding when designing and making quality products;
- AO3 Capability through acquiring and applying knowledge, skills and understanding when evaluating processes and products; and examining the wider effects of design and technology on society.

Assessment Components 1-8 Terminal Examination papers
These will test candidates' specialist knowledge, skills and understanding of Systems and Control Technology through questions on the subject content (section 5) outlined in the specification.

Assessment Component 9 Internal Assessment (coursework)
Internal Assessment (coursework) will test the knowledge, skills and understanding necessary to design and make products in the appropriate media. The evidence required to be submitted for this task must include a 3 dimensional product with a concise portfolio and/or appropriate ICT evidence.
Internal assessment will be evaluated against the following six internal assessment objectives:
(see guidance Section 7.3.2)

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

Specification content

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

- Candidates should be able to:
- demonstrate a sound working knowledge of materials and composites;
- select materials relative to their characteristics, properties and performance;
- select and use tools, equipment and processes effectively and safely to make products that match a specification;
- recognise common materials and their applications;
- pure and alloyed metals, softwood, hardwood, manufactured boards, thermoforming and thermosetting plastics and composites;
- use 'Smart' and modern materials as they become commercially available i.e. electroluminescent panels, memory metals etc.
- understand that materials deform if subjected to sufficient force and the importance of this when designing: i.e. tensile or hardness testing of materials, tests on glued joints;
- identify and compare the following when selecting materials: ductility, plasticity, hardness, malleability, brittleness, toughness, elasticity, conductivity, insulation (thermal and electrical), strength (compression, tension, shear, bending, torsion);
- appreciate that temperature can affect physical properties i.e. rigidity.

Components

Candidates should be able to:

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

Energy

Candidates should be able to:

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

5.2.2 Systems and Control (5a)

Electronics

Candidates should be able to:

- use circuit symbols for common components;
- give examples of conductors and insulators;
- understand and apply the units used to measure current, voltage, resistance and capacitance including multiple and sub-multiple units;
- design simple circuits in block diagram form, involving appropriate input sensors i.e. light, temperature, moisture, process components and appropriate output devices (lamp, motor, solenoid) for different applications;

- use Ohm's law for simple calculations;
- perform power calculations using P = V x I;
- calculate the resistance of two or more resistors in series using: $R_s = R_1 R_2 R_3$;
- understand the action of common switches i.e. toggle switch, push switch, micro-switch, SPST, SPDT, DPDT, NO, NC;
- understand the use of a diode as a one way conductor; use LED's in circuits selecting suitable current limiting resistors;
- identify transistor pins from a diagram or data sheet.

Mechanisms and structures

Candidates should be able to:

- build working models and practical devices using resistant materials and kits;
- analyse and describe mechanisms in terms of input, process, output and feedback; recognise the difference between open and closed loop systems;
- recognise both natural and man-made structures as they occur in:
    - plants, trees, honeycombs, webs, animal skeletons;
    - bridges, cranes, pylons, roofs, domestic furniture.
- explain and use in simple calculations the terms: load, effort, fulcrum;
- apply the concept of equilibrium as a result of applied load and reaction;
- explain the practical applications and uses of levers: first, second and third order;
- use the principle of levers to design and make a simple machine;
- sketch simple examples of levers and linkages in use;
- use the unit of force (Newton);
- define a moment as force x distance, use moments in simple calculations (Nm);
- carry out simple calculations of moments of forces applied and exerted by the ends of a lever, i.e. can-crushing machine;
- recognise frames in use and identify the use of triangulation to establish rigidity;
- use different methods of reinforcing such as gussets, ribs, braces, laminating;
- calculate simple gear ratios and transmission speed;
- recognise and give examples of types of motion: rotary, linear, oscillating, reciprocating;
- understand the terms - crank, cam, follower and describe their use in converting linear motion to rotary motion and vice versa.

5.2.3 Products and Applications (6a)

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

- checking design proposals against design criteria;
- establishing the function and application/s of the product;
- identifying the constituent parts of the product and their interrelated functions;

- establishing how the product works including any scientific principles involved;
- identifying the materials from which the product is manufactured;
- identifying the manufacturing processes used to make the product;
- recognising the difference between quality of design and quality of manufacture, and use essential criteria to judge the quality of other people's product.

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

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

- an understanding of standards that could be set during production to ensure control over quality;
- how far existing products satisfy their needs and fulfil their purpose i.e. a well made mechanical toy that is of no interest to a child;
- when assembling products, candidates should understand the importance of accuracy;
- the appropriate use of resources and materials in relation to manufacture and maintenance e.g. use of aluminium for ladders, use of lithium in batteries, polyester for capacitors;
- use a range of industrial applications when working with familiar materials and processes;
- how it meets manufacture and maintenance requirements;
- an understanding of a variety of finishing processes and why they are important for aesthetic and functional reasons;
- its social, moral, economic, environmental and aesthetic implications i.e. advantages and disadvantages of mobile phones, consideration of the style of the product, its disposal and recycling of materials and components.

5.2.5 Health and Safety (2a)

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

(a) As designers and consumers:

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

(b) As workers within the production environment

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

(c) Personal safety:

- protective wear including eye protection, clothing;
- machine guards;
- dust and fume extraction;
- disposal of waste;

- use of barrier creams;
- accident procedure.

(d) Risk assessment – using information sources:

- COSHH e.g. fumes from some adhesives, etching chemicals;
- instructions relating to the use of consumables i.e. solvent cement, impact adhesives, Superglue, etching chemicals;
- instructions relating to the use of unfamiliar equipment i.e. air compressor;
- recognition and understanding of safety symbols (UK and European).

(e) Environmental effects:

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

.

5.5 MECHANISMS OPTION

5.5.1 Mechanisms

Candidates should be able to:

General Concepts

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

Transmission of Motion

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

Bearings and Lubrication

- compare and contrast the use of plain, roller and ball bearings, and give reasons for their suitability for specific operational conditions;

- describe the types of lubrication, and the methods of application for different situations.

Conversion of Motion

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

Systems and Control
Year 10 Projects

During year 10, students will undertake a series of FPTs which can help them with elements of their main coursework assignments or be substituted if problems are encountered. Appropriate homework's have been set that will further build on student's experiences in class. Deadlines for FPTs and the main coursework project are to be set each term to reflect the school calendar of events.

*** Extension activity**

Term	Project Outline & Learning Experiences	Sequence of Lessons	Resources	Homework
Year 10 **Term 1**	**Project 1 – Buggy** **Design Brief:** Design and manufacture a steerable buggy. **Description:** Students will design and manufacture a small umbilical controlled buggy using foamed PVC (Foamex) for the chassis, two motors for power/steering and produce a circuit board/handcontroller unit.	Introduction to the first project - The Buggy. Maximum size. Material available 150 X 210 X 6 mm Foamex for the chassis. Explain how it will work/be assembled. How circuit/hand controller will work. Look at exemplar projects. Demonstration of speed/torque considerations. Start design ideas for chassis shape/motor layout/wheel configuration etc. Design ideas for handcontroller unit. Draw out design in ProDesktop. Use library of components to assist in producing realistic designs. ***Draw all of components (motor in particular)**	Chalkboard/Marker board. Examples of components and materials to be used. Exemplar models (previous work/line following buggy etc) Focus on Mechanisms software. ProDesktop software	Consider design considerations/possible ideas. Finalise idea for buggy, giving particular reference to front wheel carrier. Complete design

	Appropriate research opportunities: Other control methods (line following buggy, remote control etc) Types of switches. Commercial PCB manufacture. **Multi Material opportunities:** Types of plastic (Foamex, HIPS, acrylic) **Opportunities to manufacture in quantity:** The use of jigs and devices to enable batch production are considered. Laser cut chassis **Industrial applications, systems and control:** Templates, CAD/CAM, and jigs considered. Industrial finishes are also discussed.	Produce 'Album' and 'Orthographic drawing' of the design. Demonstrate exporting .dxf files to be cut on the laser cutter/mill. Print out .dxf file for a template for the chassis. Mark out and produce chassis, either using laser cutter or printed template from Prodesktop. Drill holes for motors and attach with drive wheels. Manufacture front wheel carrier and assemble. Demonstration of circuit board manufacture. Demonstration of soldering. Solder switches to hand controller circuit board. Start to manufacture hand controller unit (Vacuum form or by fabrication). Complete assembly and test. Competition for completed buggies. Speed, manoeuvrability, control, ability to climb an incline. Final display of buggies and assessment. (Total time 9 weeks)	Printer/Laser cutter Foamex. Hand tools (coping saw, files, grades of wet'n'dry paper etc) Etch tank/light box. Complete circuit board, switches, soldering iron, solder. Hand tools as above. Chalk to mark out track, stopwatch.	Research into jigs and templates. Research into switch types Planning sheet for soldering Final evaluation

Term	Project Outline & Learning Experiences	Sequence of Lessons	Resources	Homework
Year 10 Term 1	**Project 2 – Bath level alarm** **Design Brief:** Design and manufacture an alarm to indicate water level in a bath. **Description:** Students will design and manufacture an electronic device to warn users when a bath has reached a predetermined level. **Appropriate research opportunities:** Sensing systems. Attaching items to smooth surfaces. Commercial PCB manufacture. **Multi Material opportunities:**	Introduction to project. Set Design Brief, pupils to produce Design Specification. Investigation into sensing water level ('ball cock' type float/ball in a tube/prongs etc), fixing to bath side and possible materials/manufacturing techniques. Research into existing/similar products. Produce design ideas (hand drawn). Development – details of design. Consideration to bath fixing/battery access/sound etc. Transfer design into ProDesktop. Produce 'album' and orthographic drawing from the design. ***Draw a bath and produce the album drawing of the object in situ.** Recap of circuit board manufacture. Recap of soldering. Basic theory of components used. Solder components to circuit board.	Paper, past exemplar projects, Internet access. As above. Computers/ProDesktop, printer. Circuit board, components (Yr 8 moisture detector circuit), soldering irons, solder etc.	Present research – product analysis. Complete design Advantages/disadvantages of CAD. Table of components – names/symbols/function.

	Types of plastic (Foamex, HIPS, acrylic) **Opportunities to manufacture in quantity:** The use of jigs and devices to enable batch production are considered. Laser cut chassis **Industrial applications, systems and control:** Templates, CAD/CAM, and jigs considered. Vacuum forming. Injection moulding.	Manufacture of casing. Mainly vacuum formed although not prescriptive. Attach circuit/switches/sensor etc. Test. Final evaluation and assessment.	MDF for moulds (4 off 150x75x12) to be laminated together. Vacuum former and Styrene. Other materials as required. Hand tools. Hot glue gun. Tools as above. Evaluation sheets	Planning sheet for manufacturing mould Improvements to design if it were to be mass produced.

Term	Project Outline & Learning Experiences	Sequence of Lessons	Resources	Homework
Year 10 Term 1	**Project 3 – Mechanisms** **Design Brief:** Manufacture a range of models to demonstrate a variety of mechanical systems. **Description:** Assemble pre-cut mechanism kits for Cams, Crank and Slider, and Gears. Produce a Powerpoint presentation into mechanical systems, **Appropriate research opportunities:** Mechanisms and application of mechanisms **Multi Material opportunities:** Theory of what materials are used and why.	Introduction to project. Research into mechanism types using Focus on Mechanisms. Assemble Crank and Slider kit. Assemble Gears and Cams kit. Introduction into how to use Powerpoint. Slides/backgrounds/animation/importing etc. Pupils to produce Powerpoint presentation on mechanisms. Use images from Focus on Mechanisms, the Internet etc to illustrate. Continue with presentation.	Focus on Mechanisms software. Kits (1 per pupil). Kits (1 per pupil). Computers/Powerpoint. As above	Write up uses of Mechanisms looked at during lesson. Research into use/application of crank and slider Research into use/application of cams/gears/ Background for slide. Complete presentation

	Opportunities to manufacture in quantity: Laser cut components for assembly. **Industrial applications, systems and control:** CAM.	Pupils to give presentations to the rest of the class. Assessment of presentation.	As above, access to projector	

Term	Project Outline & Learning Experiences	Sequence of Lessons	Resources	Homework
Year 10 **Term 1**	**Project 4 – ProDesktop** **Description:** A variety of exercises will enable students to develop and enhance their skills in using ProDesktop. Advanced drawing features will be used as well as producing assembly drawings, animations and photorealsistic images in the Album. Exporting 2d .dxf files and 3d .stl files will also be covered. **Appropriate research opportunities:** Uses of CAD/CAM in industry. **Multi Material opportunities:** N/A **Opportunities to manufacture in quantity:**	Students will be shown the following features by drawing the following objects. Students are encouraged to install Prodesktop on their home PC. Recap – basic drawing skills. Drawing simple shapes, extruding, selecting faces/edges, dimensioning. Introduction to assembly drawings. Simple cabinet with a drawer and door. 4 files – 'Cabinet' 200 x 100 x 100, apply a 10mm shell to the front, 'Door' 200 x 100 x 10, 'Drawer' 80 x 90 x 30, apply a 5mm shell. 'Assembly' assembly drawing bringing the components together. Demo of align, mate centre axis, fix component. *** Produce an assembly drawing of a crank and slider.**	Prodesktop CD's PC's/Prodesktop/projector. As above. As above plus colour printer.	Install Prodesktop. Practice Prodesktop. As above. As above.

	N/A **Industrial applications, systems and control:** Commercial uses of CAD, advantages/disadvantages, links with CAM.	Produce orthographic drawing. Add base and place image in Album. Use project/extrude to remove circles and drawn shapes from solid objects. Draw a 5 litre paint container. Use duplicate cicular array for the grips on the lid. ***Produce a hollow container with a screw thread on the spout, and a separate lid with an internal thread.** Produce an album and orthographic drawing of the container. Demo exporting a .jpg image from the album and importing into XaraX or Word. Pupils to produce a simple step by step guide of producing the cupboard using screen shots and .jpg images using either Word or XaraX. Demo exporting .stl files. Pupils to see how a 3D object can be manufactured on the 4 axis mill. Demo exporting .dxf files. Pupils to see how a 2D shape can be exported and cut on the Laser cutter.	As above. As above As above. As above plus 4 axis mill and foam. As above plus laser cutter and acrylic.	As above. Add finishing touches to enhance. Research into advantages/disadvantages of CAD/CAM

Term	Project Outline & Learning Experiences	Sequence of Lessons	Resources	Homework
Year 10 Term2	**Project 5 – CAD/CAM money box** **Design Brief** Keeping loose change in place where you can easily find it always seems to be an impossible task, as loose change seems to be littered all over the place. Students are to design and make a money box to keep all loose change. **Description** Students will produce a box module from 5 mm Acrylic. The unit will be designed and constructed using CAD/CAM. The unit will be designed on 2D design and manufactured using the laser cutter. The	Introduction to project on CAD/CAM moneybox. All flat pack parts to fit onto a piece of A4 paper Explanation to class on production processes to include, single, mass, and batch production. CAD/CAM introduced as a method of production. Explanation to the class of the need for a batch production for this project which will need to assure quality of build. To include finish, build quality and the need for an identical product each time. To solely be designed on CAD using 2D design, and to realised using CAD in the way of the laser cutter. Introduction to 2D design, go through on the overhead, functions and screen of 2D design explaining all toolbars and features .Explain through different drawing modes etc…Simple introduction exercise of drawing and designing a	Computers CAD- 2D design programme, ProDesktop CAM- laser cutter, vinyl cutter Acrylic 5mm. card Tensol cement. 2D Design icon worksheet.	Produce initial ideas, and final idea for CAD/CAM money box Use text book to research the advantages and disadvantages of CAD/CAM Read about mass production and the use of jigs and other

	box will be constructed using comb/finger joints and will contain some kind of engraving which will also be designed on CAD. The unit will contain a slot for the money and also some method of retrieving the money by means of an opening. **Appropriate research opportunities:** Research a range of commercial joints to see how they work, their uses and advantages. **Multi Material opportunities:** Thermosetting and thermoplastic, such as styrene and acrylic **Opportunities to manufacture in quantity:** The use of CAD/Cam machines, the laser	sign, to go on a house or a gate. Complete exercise booklet on 2D design, drawing of a game boy. *** Design a phone face on 2D design.** Demonstration of the production and assembly of CAD/CAM boxes, explaining joints and the type of joints to be used for the box and why. Links to industrial practises and processes. Demonstrate the types of layouts and designs for box, explaining the need for space saving when using the 2D design layout. Demonstration on the use of CAD/CAM for engraving. Demo on the laser Cutter. Students to work on there own designing the money box and working on 2D design. Demonstration of the use of adhesives and clamping devices. Demonstration - Use of abrasives - going through the grades. A good finish. Explaining the cut on the laser and the need for less of a finish.	As above Production video. Laser cutter. Tensol, clamps. Wet'n'dry, Brasso.	devices used in the production of manufactured wooden items Complete a plan of make. Evaluation to be done on final product Study for end of unit test.

	cutter. Modelling opportunities **Industrial applications, systems and control:** Templates, CAD/CAM, Modelling in card Industrial finishes are also discussed. The use of laser cutting and Vinyl cutting machines.	By this point the class should have completed the design work and be ready to laser the acrylic. Money boxes should now be laser cut in card first to produce a prototype model and constructed. Explain this with class go through process and link to industry. Class to adjust the design of the box if needed. Then move on to using acrylic. Students to assemble money box and apply finish. Test, final evaluation and assessment.	Laser cutter, card.	

Homework

Homework will be set regularly in line with current school policies for the first three terms of the two year course (Year 10). Homework will consist of a variety of tasks as outlined in the previous Schemes of Work.

Homework for Year 11 will center around the production of coursework, and preparation/revision for mock and final exams.

Year 11

Term 3	Term 3	Term 3
1. Individual needs for student's coursework.	1. Individual needs for student's coursework	1. Homework will focus on end of year examinations using exemplar exam questions focused on relevant areas of study

Coursework Monitoring and Feedback

- During the 2 year course, feedback will be continuous and cumulative. Students will be issued with a sheets/booklet that will be used to record progress throughout the course for each project and main coursework project.
- Common deadlines will be set for each piece of coursework for the entire course and regular feedback to pupils on how the are progressing, and targets will be set.
- Letters will be sent home at the start of the first and second year notifying parents of deadlines.
- Positive letters of commendation will also be sent home as appropriate.

Coursework Assessment

Because of the nature of design and technology work, students work will be marked in a flexible, integrated and holistic way.

Work will be informally assessed during project work with feedback given to the student and formally when estimating the candidates overall final grade.

Candidate's work shall be measured against exemplar material which illustrates standards with criteria for grades (A*-G)

Grade Descriptions

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

Grade F

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

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

Grade C

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

- use a wide range of appropriate sources of information to develop ideas;
- use a range of strategies to develop ideas, responding to information they have identified;
- investigate form, function and production processes and communicate ideas, using appropriate media;
- recognise the needs of users and develop realistic designs;

- produce plans that make use of time and resources to carry out the main stages of making products;
- work with a range of tools, materials, equipment, components and processes, taking account of their characteristics;
- organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision;
- adapt their methods of manufacture to changing circumstances, providing a sound explanation for any change from the initial specification;
- select appropriate techniques to test and evaluate how their products would perform when used and modify their products in the light of ongoing evaluation to improve their performance;
- evaluate their use of information sources.

Grade A

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

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

Assessment Units

The Scheme of Assessment comprises two components.
All questions are compulsory.
Questions will test the application of knowledge and understanding of materials, components, processes, techniques, technologies and the evaluation of commercial practices and products.
Questions will largely address general aspects of product design which cross all material area, although some questions will allow subject specific knowledge to be shown.

The coursework project will be internally assessed and externally moderated.
The project should address all three assessment objectives in an integrated way.
Candidates are required to submit a 3-dimensional product or outcome and a concise design folder and/or the appropriate ICT evidence.
Candidates have the freedom in product design to use the type and variety of materials necessary to satisfy their design brief.
Throughout the project candidates should address the industrial and commercial practices, and the moral, social, cultural and environmental issues, arising from their work.

Moderation / Standardisation Main Coursework Project Work

Students work will initially be internally moderated by teachers delivering the course thus enabling teachers to achieve a common agreement about standards. To facilitate this, a minimum sample (where possible) of one of each of the following pieces of students work should be used for standardising grades; ‘A’, ‘C’, ‘D’ and ‘F’. Teachers from other D&T subject focus areas will be invited to standardize a sample of work. Once a standard has been agreed, teachers will continue to mark the cohort of work.

Examining body moderation of the coursework is by inspection of a sample of candidates' work. This will initially involve design folders for the sample being sent by post from the centre to the moderator appointed by the examination board.

Preparing Coursework Portfolios for Assessment

The following checklist should be used before work is finally assessed and moderated before the set deadline has expired:

Ensure that:

- candidate’s work should has a front cover with their name, candidate number, the name of the project, the name of the school and the school center number.
- each portfolio has a contents sheet.
- each page is individually numbered to correlate with the contents sheet.
- references and bibliography is included listing all sources of information.

- the students has met all of the assessment criteria.
- the work is in the correct order.

Some work carried out will not result in hard evidence, for example, visits to industry or business and phone calls to companies or watching a video. It is helpful to have at least a record of all activities undertaken by a student by including a log sheet in the portfolio to complement the reference section.

Key Skills

Opportunities to develop and generate evidence of achievement in all six of the key skills will be offered during the Product Design course:

Communication
Application of Number
Information Technology
Working with Others
Improving Own Learning Performance
Problem Solving

Examples of the application of Key Skills in Design and Technology will be displayed appropriately ‘Signposting’ opportunities.