



BOTSWANA
EXAMINATIONS
COUNCIL

BOTSWANA GENERAL CERTIFICATE
OF SECONDARY EDUCATION

ASSESSMENT SYLLABUS

DESIGN & TECHNOLOGY
CODE 0595



Effective for examination from 2019

0595
CODE

Changes in the syllabus

Syllabus content

There are **no** changes in the content of the syllabus.

Structure of assessment

The assessment structure has **not** changed.

There is detailed information on the relationship between the assessment objectives and the components indicating the weight and/or marks for each assessment objective in each component.

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1. INTRODUCTION

As part of the Senior Secondary Education Programme, the Design and Technology Assessment Syllabus is designed to assess candidates who have completed a two-year course based on the Senior Secondary Design and Technology Teaching Syllabus.

This syllabus aims to assess positive achievement at all levels of ability and candidates will be assessed in ways that encourage them to show what they know, understand and can do. The syllabus will be assessed by two papers, details of which are given in Section 4 and 6. Differentiation will be achieved by task and outcome, with all candidates sitting the same papers, based on common content.

Candidates will be graded on a scale A - G. As a guide to what might be expected of the candidate's performance, grade descriptions are given later in Section 7.

This syllabus should be read in conjunction with:

- (a) the Senior Secondary School Design and Technology Teaching Syllabus;
- (b) the specimen question papers and marking schemes.
- (c) the Design and Technology *Coursework Assessment and Marking Scheme*.

Syllabus-specific requirements and any further information are given in the Appendices.

Progression

The BGCSE is a general qualification that enables candidates to progress either directly to employment or to proceed to further qualifications.

2. SCHEME OF ASSESSMENT

The syllabus is assessed through one written paper and coursework (Major Project).
All candidates will sit Papers 1 and 2.

Candidates will be graded A-G. Those failing to achieve grade G will be unclassified (U) and no grade will appear on the certificate.

2.1 The components

Written Paper

Paper 1

2 hours 30 minutes

100 marks

Weighting 50%

This paper will consist of three sections: A, B and C

Section A

10-15 short answer questions on safety, materials, processes, tools, fittings, fixings, design, energy and environmental issues.

40 marks

Section B

Two structured questions on tools, materials, processes, problem solving, safety and technology.

40 marks

Section C

Three structured questions on design and communication covering electronics, pneumatics, mechanisms and structures. Candidates will be expected to answer one question from this section.

20 marks

This paper will cover Assessment Objectives 1,2 and 3

Coursework

Paper 2

Major Project

Marks 100

Weighting 50%

A classroom and workshop based paper, internally assessed and externally moderated.

This paper will address Assessment Objectives 2 and 3 (including manipulative skills).

The paper will have a thematic approach, whereby a general theme is presented by Botswana Examinations Council to candidates at the end of term 3 of Form 4. Candidates are required to start the major project at the beginning of the first term of their final year and complete it by mid-October of the same year.

Further details can be found in Section 6, and in the *Coursework Assessment and Marking Scheme*.

2.2 Availability

This syllabus is available to school candidates and private candidates.

3. SYLLABUS AIMS AND ASSESSMENT OBJECTIVES

3.1 Aims

Candidates following this syllabus should have acquired and developed:

1. a range of knowledge and skills applicable to further training, higher education and/or employment;
2. an understanding of concepts and principles of systems including mechanical, electrical and electronic;
3. an understanding of the properties of a variety of materials and systems so as to apply processes appropriate to their manipulation and transformation;
4. an understanding of the origins of technology and its impact on our lives and how it has influenced today's world;
5. technological literacy by applying various communication skills and information systems;
6. skills to manage available resources effectively;
7. entrepreneurial skills that are relevant to the world of marketing and production;
8. skills to adapt different technologies to suit local contexts;
9. skills which will allow them to demonstrate dexterity, critical thinking, ingenuity, initiative, resourcefulness and discriminate information as they purposefully design and make useful products for their community;
10. capabilities for safe manipulation of materials, tools and equipment;
11. sound fabrication skills that enable them to work with a variety of materials, tools and equipment;
12. a range of positive values and attitudes of social responsibility and co-operation;
13. an understanding and application of basic principles of problem solving processes;
14. abilities to be responsible for their own development;
15. sensitivity to their environment as they design and make products for the real world;
16. awareness of the link between technology and the world of work.

As far as possible, Aims will be reflected in the Assessment Objectives, however, some aims may not be readily assessable.

3.2 Assessment Objective

The Assessment Objectives are grouped into three areas; **Knowledge and Understanding**, **Application of Knowledge and Skills** and **Problems Solving Skills**.

AO1. Knowledge and Understanding

Candidates will be assessed on their ability to:

- 1.1 demonstrate sound knowledge of materials and processes;
- 1.2 understand technological concepts;
- 1.3 understand technical terms;
- 1.4 understand the design process;
- 1.5 acquire knowledge of research and acquisition of data;
- 1.6 demonstrate sound knowledge of tools and equipment;
- 1.7 understand safety procedures.

AO2. Application of Knowledge and Skills

Candidates will be assessed on their ability to:

- 2.1 use technical terms;
- 2.2 apply knowledge of the design process to real life contexts;
- 2.3 communicate ideas clearly in written and graphical forms;
- 2.4 produce drawings according to the International Standard Organisation (ISO);
- 2.5 interpret drawings according to the ISO;
- 2.6 apply acquired knowledge and skills to new situations;
- 2.7 apply sound knowledge of tools and equipment.

AO3. Problems Solving Skills

Candidates will be assessed on their ability to:

- 3.1 use technological concepts to solve real life problems;
- 3.2 identify real life problems in the community;
- 3.3 apply knowledge of research methods and data gathering techniques to solve problems.
- 3.4 justify their solution to a problem;
- 3.5 demonstrate creativity in their work;
- 3.6 design environmentally friendly products;
- 3.7 make good quality products;
- 3.8 advertise and market their products;
- 3.9 test and evaluate their products;
- 3.10 solve real life problems in the community.

4. ASSESSMENT OBJECTIVE AS A PERCENTAGE OF EACH COMPONENT

The following grid summarises the connection between the Assessment Objectives and the papers.

Assessment Objectives	Paper 1	Paper 2	Total
1. Knowledge and understanding	20% (40)	-	20%
2. Application of Knowledge and skills	20% (40)	20% (40)	40%
3. Problem Solving Skills	10% (20)	30% (60)	40%
Total	50% (100)	50% (100)	100%

5. CONTENT

Section 1: Health and Safety

- (a) Safety precautions
- (b) First aid (theory only)

Section 2: Materials

- (a) Timber
- (b) Manufactured boards
- (c) Metals
- (d) Plastics
- (e) Adhesives
- (f) Abrasives
- (g) Fixings
- (h) Fittings
- (i) Finishes

Section 3: Communication

- (a) Graphics
- (b) Information Technology (theory only)

Section 4: Design

- (a) Design process
- (b) Marketing
- (c) Promotion
- (d) Costing and pricing production

Section 5: Technology

- (a) Structures
- (b) Mechanisms
- (c) Energy
- (d) Electronics
- (e) Pneumatics

Section 6: Practical Skills and Processes

- (a) Measuring and Marking out
- (b) Saws and sawing
- (c) Planes and Planing
- (d) Files and Filing
- (e) Drills and drilling
- (f) Chisels and Chiselling
- (g) Shears and shearing
- (h) Forming, moulding and casting
- (i) Turning and milling
- (j) Joining and fabricating
- (k) Holding and assembling tools
- (l) Finishing material

1. HEALTH AND SAFETY

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
1.1 Safety precautions	1.1.1 acquire and apply knowledge of workshop safety precautions.	1.1.1.1 list the general workshop safety precautions. 1.1.1.2 identify possible work hazards in the workshop including eye, skin, fire, respiratory and explosion hazards. 1.1.1.3 state possible ways to minimise or control the identified work hazards. 1.1.1.4 work safely with a range of materials, tools and equipment. 1.1.1.5 justify the actions taken to control risk.
1.2 First aid	1.2.1 acquire basic knowledge of first aid	1.2.1.1 describe the treatment of cuts, bruises, burns and electrical shocks. 1.2.1.2 describe the preventative measures of handling any contagious infections (e.g. AIDS and HIV).

2. MATERIALS

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.1 Timber <i>S.A. Pine</i> <i>Jelutong</i> <i>Meranti</i> <i>Mukwa</i> <i>Oak</i> <i>Mukusi</i> <i>Iroko</i> <i>Teak</i> <i>Sapele</i>	2.1.1 acquire and apply knowledge of the prescribed timber.	2.1.1.1 identify the prescribed timber. 2.1.1.2 classify the prescribed timber into hardwoods and softwoods. 2.1.1.3 differentiate between plain, radial and tangential sawing. 2.1.1.4 describe the methods of seasoning timber. 2.1.1.5 list advantages and disadvantages of seasoning timber. 2.1.1.6 describe the mechanical properties of timber in terms of strength, hardness, toughness, elasticity, durability and density.
2.3 Manufactured boards <i>Blockboard</i> <i>Chipboard</i> <i>Hardboard</i> <i>Peg board</i> <i>Softboard</i> <i>Plywood</i> <i>Medium density fibre board (MDF)</i>	2.2.1 acquire and apply knowledge of the prescribed manufactured boards	2.1.1.7 identify and explain the causes of timber defects including knots, shakes, warping, waney edges, shrinkage and pitch pocket. 2.1.1.8 preserve timber using creosote, water borne and organic preservatives. 2.1.1.9 make informed decision about the type of timber to be used. 2.1.1.10 list the safety precautions to be taken when using timber

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.3 Metals <i>High carbon steel</i> <i>High speed steel</i> <i>Low carbon steel</i> <i>Stainless steel</i> <i>Tool steel</i> <i>Mild steel</i> <i>Wrought iron</i> <i>Cast iron</i> <i>Aluminium</i> <i>Copper</i> <i>Brass</i> <i>Lead</i> <i>Zinc</i> <i>Tin</i>	2.3.1 acquire and apply knowledge of the prescribed metals.	2.3.1.1 identify the prescribed metals by appearance and weight. 2.3.1.2 classify the prescribed metals into ferrous, non-ferrous, pure and alloys. 2.3.1.3 state the composition of the prescribed alloys. 2.3.1.4 explain the processes involved in producing steels. 2.3.1.5 describe the production of aluminium. 2.3.1.6 state the marketable forms and sizes of metals. 2.3.1.7 list the common uses of the prescribed metals. 2.3.1.8 explain how the carbon content of steel affects its working properties. 2.3.1.9 explain the importance of heat treatment in metals including annealing, tempering, normalising, hardening and case hardening. 2.3.1.10 describe the properties of metals in terms of density, toughness, ductility, hardness, malleability, brittleness, elasticity, plasticity, fusibility, chemical, magnetism, acoustics, conductivity and strength. 2.3.1.11 describe the different methods of manufacturing metal products including blanking, press forming, forging, drop forging, cold heading, drawing, thread rolling, extrusion, sand casting, die casting, turning, milling, grinding, threading, rolling and drilling. 2.3.1.12 make informed decisions about the type of metals to be used.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.4 Plastics <i>Polyamide (Nylon)</i> <i>Polymethyl methacrylate (Acrylic)</i> <i>High density polythene</i> <i>Low density polythene</i> <i>Latex and rubber</i> <i>Rigid polystyrene</i> <i>Expanded polystyrene</i> <i>Polypropylene</i> <i>Polyester resin</i> <i>Polyvinyl chloride (PVC)</i> <i>Urea formaldehyde</i> <i>Phenol formaldehyde</i> <i>Melamine</i> <i>Formaldehyde</i> <i>Glass reinforced</i> <i>Plastic (GRP)</i> <i>Acrylonitrile butadiene styrene (ABS)</i>	2.4.1 acquire and apply knowledge of the prescribed plastics.	2.4.1.1 identify the prescribed plastics by appearance and testing. 2.4.1.2 classify the prescribed plastics into thermoplastics, thermosetting and elastomers. 2.4.1.3 state the sources and manufactures of plastics. 2.4.1.4 illustrate the different forms and sizes in which plastics are available. 2.4.1.5 describe the properties of plastics in terms of density, toughness, stiffness, hardness, brittleness, strength, elasticity, plasticity, optical, chemical, non-conductivity and plastic memory. 2.4.1.6 list the common uses of the prescribed plastics. 2.4.1.7 make informed decisions about the type of plastics to be used

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.5 Optional materials <i>Cane</i> <i>Cement</i> <i>Clay</i> <i>Glass</i> <i>Grass</i> <i>Leather</i> <i>Papers/cards</i> <i>Soap stone (This list is not exhaustive)</i>	2.5.1 be encouraged to acquire knowledge of locally available materials and use them where appropriate	2.5.1.1 identify locally available materials. 2.5.1.2 state sources and manufacture of locally available materials. 2.5.1.3 list common use of locally available materials. 2.5.1.4 make informed decisions about the type of optional materials to be used. 2.5.1.5 list the safety precautions to be taken when using optional materials.
2.6 Adhesives <i>Hot plastic glue</i> <i>Polyvinyl acetate (PVA)</i> <i>Urea formaldehyde (Cascamite)</i> <i>Tensol cement (types)</i> <i>Contact adhesive</i> <i>Epoxy resin</i> <i>Super glue</i>	2.6.1 acquire and apply knowledge of the prescribed adhesives.	2.6.1.1 state the characteristics of each of the prescribed adhesives. 2.6.1.2 list common uses of the prescribed adhesives. 2.6.1.3 describe the preparation and application of the prescribed adhesives. 2.6.1.4 determine the pot and shelf life of adhesives. 2.6.1.5 choose the appropriate adhesives when joining materials 2.6.1.6 list the safety precautions to be taken when using adhesives.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.7 Abrasives <i>Glass paper</i> <i>Emery cloth</i> <i>Garnet paper</i> <i>Steel wool</i> <i>Metal polish</i> <i>Aluminium oxide</i> <i>Buffing compound</i> <i>Rubbing compound</i>	2.7.1 acquire and apply knowledge of the prescribed abrasives	2.7.1.1 list the different grades of abrasives. 2.7.1.2 identify the grit materials used for abrasives. 2.7.1.3 describe the correct methods of using abrasives. 2.7.1.4 choose the appropriate abrasives to get the desired finish. 2.7.1.5 list the safety precautions to be taken when using abrasives.
2.8 Fixings <u>Nails</u> - round wire, oval brad, clout, panel pin, cut tack, tack, gimp pin, masonry, staples and corrugated fastener. <u>Wood screws</u> - round head Countersunk head, raised head, twinfast and coach. <u>Self-tapping screws</u> – countersunk head, round head, raised head, Pan head, mushroom head and security head.	2.8.1 acquire and apply knowledge of the prescribed fixings.	2.8.1.1 identify and illustrate the prescribed fixings. 2.8.1.2 label the parts of the prescribed fixings. 2.8.1.3 list the common uses of the prescribed fixings. 2.8.1.4 describe the stages involved when using fixings. 2.8.1.5 choose the right type of fixing for joining materials. 2.8.1.6 list the safety precautions to be taken when using fixings

<p><u>Machine screws</u> – round head, countersunk head, pan head Cheese head Grub and socket / allen. <u>Rivets</u> - countersunk head Round / snap head, Raised head Flat head Pop, Bifurcated head and eye let. <u>Bolts</u>- coach head, hexagonal head, square head and gutter. <u>Nuts</u> – hexagonal head, square head, lock, dome/decorative, fibre lock, castle and split pin. <u>Washers</u> - plain, lock and spring) <u>Threaded bars and studs</u> <u>Plugs</u> – rawlplug, rawlbolt, butterfly and expansion bolt. <u>Velcro</u></p>		
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TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.9 Fittings <u>Hinges</u> – butt, back flap, tee, piano, flush, concealed, cranked cabinet, surface and rising butt. <u>Catches</u> – magnetic, ball and spring. <u>Latches</u> – night, barrel bolt, hasp and staples <u>Locks</u> - cylinder, cupboard, cut cupboard, drawer, mortice and pad. <u>Stays</u> – flat, lockable, spring and hydraulic. <u>Plates</u> – mirror and escutcheon/keyhole. <u>Knock down</u> – chipboard insert, screw socket, block joint, modesty block, leg fastening and shelf support. <u>Handles/knobs Castors</u> <u>Buttons</u>	2.9.1 apply knowledge of the prescribed fittings	2.9.1.1 identify and illustrate the prescribed fittings. 2.9.1.2 label the parts of the prescribed fittings. 2.9.1.3 list the common uses of the prescribed fittings. 2.9.1.4 describe the stages involved when using fittings. 2.9.1.5 use fittings where appropriate when making products. 2.9.1.6 list the safety precautions to be taken when using fittings.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
2.10 Finishes <u>Sandling sealer</u> <u>Paint – primer, undercoat, matt and gloss.</u> <u>Stain – water and oil based.</u> <u>Varnish – internal and external.</u> <u>Lacquer</u> <u>Wax</u> <u>Linseed oil</u> <u>Galvanising</u> <u>Bluing</u> <u>Enamelling</u> <u>Anodising</u> <u>Dip coating</u> <u>Electroplating – tin, brass, silver and chrome.</u> <u>Solvents – paraffin, thinners, white spirit, turpentine and water.</u>	2.10.1 acquire and apply knowledge of the prescribed finishes.	2.10.1.1 identify the prescribed finishes, 2.10.1.2 state the characteristics of each of the prescribed finishes. 2.10.1.3 list common uses of finishes. 2.10.1.4 describe the stages involved when using finishes. 2.10.1.5 determine the pot and shelf life of finishes. 2.10.1.6 choose appropriate finish for given product. 2.10.1.7 use finishes where appropriate when making products. 2.10.1.8 list the safety precautions to be taken when using finishes.

3. COMMUNICATION

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
3.1 Graphics	3.1.1 acquire and apply knowledge of graphical communication.	3.1.1.1 sketch objects in isometric, one and two-point perspective. 3.1.1.2 enhance drawing using different presentation techniques including sequence diagrams, sketching, assembly drawing, exploded view, flow charts, tone shading, colouring, texturing and air brushing. 3.1.1.3 produce working drawings in first and third angle projection. 3.1.1.4 determine true lengths of simple truncated solids including cubes, prisms, pyramids, cylinders, and cones. 3.1.1.5 draw surface developments of truncated solids and blocks. 3.1.1.6 communicate ideas using models. 3.1.1.7 convert pictorial drawings to orthographic drawings and vice-versa.
3.2 Information Technology	3.2.1 understand the application of information technology in engineering.	3.2.1.1 define information technology as applicable to desktop publishing and control. 3.2.1.2 recognise that computer systems can control machines and equipment. 3.2.1.3 demonstrate an understanding of the uses of CAD/CAM in the manufacturing of single items, small batches and quantity. 3.2.1.4 produce working drawings or artwork using paint or draw programmes. 3.2.1.5 express ideas and information through written text and graphics. 3.2.1.6 present data in bar and pie charts. 3.2.1.7 produce appropriate text styles and sizes for advertising a product.

4. DESIGN

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
4.1 Design process	4.1.1 acquire and apply knowledge of a design process.	4.1.1.1 define and analyse a given theme. 4.1.1.2 derive a situation from the theme. 4.1.1.3 identify and analyse a problem from the situation. 4.1.1.4 formulate a design brief. 4.1.1.5 draw up relevant specifications including function, safety, size/capacity/weight, properties of materials, structural considerations, shapes/forms/aesthetics, social and environmental factors, handling and control, health, hygiene and maintenance. 4.1.1.6 carry out relevant research that will help solve the identified problem. 4.1.1.7 explore and analyse a variety of possible solutions relevant to the problem. 4.1.1.8 progressively develop the chosen solution. 4.1.1.9 produce a detailed pictorial drawing of the developed solution. 4.1.1.10 produce a working drawing of the developed solution.
4.2 Marketing	4.2.1 acquire and apply knowledge of marketing	4.2.1.1 identify the target market for a new product. 4.2.1.2 divide the target market into segments. 4.2.1.3 list the objectives of market research. 4.2.1.4 use appropriate instruments to conduct market research. 4.2.1.5 analyse and interpret information gathered from the market research. 4.2.1.6 examine the 4ps (price, product, promotion and place).

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
4.3 Promotion	4.3.1 acquire and apply knowledge of promoting a product.	4.3.1.1 determine the packaging and brand name of a product. 4.3.1.2 decide on how to sell the product. 4.3.1.3 determine the sales promotion of a product. 4.3.1.4 decide on a form of advertisement to use.
4.4 Costing and pricing production	4.4.1 acquire and apply knowledge of costing and pricing production.	4.4.1.3 determine variable costs including materials, wages, power, etc. 4.4.1.4 estimate total output from market research information. 4.4.1.5 determine average cost. 4.4.1.6 decide on pricing (cost-plus, market penetrating, psychological). 4.4.1.7 analyse and interpret break-even statistics.

5. TECHNOLOGY

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
5.1 Energy	5.1.1 acquire and apply knowledge of energy.	5.1.1.1 describe the different forms of energy including mechanical, heat, light, electrical, chemical and sound. 5.1.1.2 identify the different sources of energy in Botswana. 5.1.1.3 differentiate between capital and income energy sources. 5.1.1.4 suggest ways of conserving energy. 5.1.1.5 explain how different sources of energy can be stored, converted and transmitted. 5.1.1.6 recognise the benefits and limitations of different sources of energy. 5.1.1.7 select appropriate energy sources in response to a given design problem.
5.2 Structures	5.2.1 acquire and apply knowledge of structures	5.2.1.1 identify and classify both natural and man-made structures. 5.2.1.2 give examples of shell and frame structures. 5.2.1.3 differentiate between static and dynamic loads. 5.2.1.4 apply the concept of equilibrium as a result of applied load and reaction. 5.2.1.5 apply the principles of moments in simple calculations. 5.2.1.6 apply the principles of triangulation to establish rigidity and stability. 5.2.1.7 describe and illustrate the kinds of forces that can act on or within a structure. 5.2.1.8 select appropriate structures to meet the demands of a design problem.
5.3 Mechanisms	5.3.1 acquire and apply knowledge of mechanisms.	5.3.1.1 identify the different components of a mechanism. 5.3.1.2 demonstrate an understanding of the input and output movement of a mechanism. 5.3.1.3 explain and use the terms; load, effort and fulcrum in simple calculations. 5.3.1.4 explain the practical applications and uses of the three classes of lever. 5.3.1.5 recognise and give examples of the practical applications of the following gears: spurs, bevel, helical, idler, worm, rack and pinion. 5.3.1.6 explain how cams, cranks and couplings are used to transmit power and motion. 5.3.1.7 give examples of the use of the linkages including reverse motion, push and pull, cranks and slider, treadle, toggle clamp and parallel motion.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
5.3 Mechanisms	5.3.1 acquire and apply knowledge of mechanisms.	5.3.1.8 determine the mechanical advantage, velocity ratio and efficiency of simple machines. 5.3.1.9 recognise the effects friction on mechanical systems. 5.3.1.10 calculate simple gear ratios and transmission speed. 5.3.1.11 recognise and give examples of the types of motion performed by cranks, cams and followers. 5.3.1.12 calculate driver/driven speeds of simple pulley and gear systems. 5.3.1.13 list advantages and disadvantages of chain and sprocket systems over the pulley systems. 5.3.1.14 select appropriate mechanisms in response to a given design problem.
5.4 Electronics	5.4.1 acquire and apply knowledge of electronics	5.4.1.1 identify the basic electronic components in a circuit. 5.4.1.2 draw and interpret electronic circuit diagrams. 5.4.1.3 explain the concepts of input, control and output. 5.4.1.4 distinguish between electrical conductors and insulators. 5.4.1.5 design and make simple electronic circuits involving a variety of inputs such as touch and LDR's sensors, microphones and outputs to lamps, motors, LED's speakers, buzzers. 5.4.1.6 explain the functions of fixed and variable resistors, polarised and non-polarised capacitors, diodes and npn transistors. 5.4.1.7 use ohms law calculation to determine current and voltage requirements. 5.4.1.8 explain the action of different switches including membrane, toggle, rocker, relays, reed, slide, push button and micro 5.4.1.9 explain the terms used in relation to switches and relays including pole, throw, normally closed, normally open and change over e.g. SPST, SPDT, DPST & DPDT. 5.4.1.10 set a potential divider 5.4.1.11 calculate the resistance of two or more resistors in parallel or in series.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
5.4 Electronics	5.4.1 acquire and apply knowledge of electronics	5.4.1.12 calculate the time constant in a charge/discharge circuit. 5.4.1.13 identify the base, emitter and collector lead of a transistor from a diagram. 5.4.1.14 describe how current flow between collector and emitter of a transistor can be controlled. 5.4.1.15 describe the use of transistors in switching devices. 5.4.1.16 identify and state the limitations of different batteries available including zinc chloride, alkaline cells, solar cells, lithium cells and nickel cadmium 5.4.1.17 use ammeters, voltmeters and multimeters to measure current, voltage and resistance. 5.4.1.18 build circuits using a variety of assembling techniques such as bread-boarding, vero-boarding and photo-etching. 5.4.1.19 use 555 timer in a monostable and astable. 5.4.1.20 use 741 as a basic comparator 5.4.1.21 conduct continuity test to detect simple faults in a circuit. 5.4.1.22 demonstrate an awareness of potential work hazards when working with electrical and electronic equipment.
5.5 Pneumatics	5.5.1 acquire and apply	5.5.1.1 identify the basic pneumatic components in a circuit. 5.5.1.2 draw and interpret pneumatic circuit diagrams. 5.5.1.3 explain the concepts of input, control and output as applicable to pneumatics. 5.5.1.4 explain the principles of air supply including compressor, receiver, operating pressures and safety features. 5.5.1.5 describe the use of a reservoir in time delay operations. 5.5.1.6 explain by means of annotated sketches the functions of single and double acting cylinders.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
		5.5.1.7 control a single-acting cylinder with a 3-port valve. 5.5.1.8 control a double-acting cylinder with a 5-port valves (pilot signal control). 5.5.1.9 control the speed of a piston using a flow control valve. 5.5.1.10 explain why a shuttle valve is used in a pneumatic logic OR circuit. 5.5.1.11 use two 3-port valves to achieve simple AND logic circuit. 5.5.1.12 explain the principles of air operated 3-port valve, double air operated 5-port valve and low-pressure air operated 3-port valve (diaphragm valve). 5.5.1.13 describe the practical applications of pneumatic time delays. 5.5.1.14 control single and double-acting cylinders using a solenoid 3-port valve. 5.5.1.15 design and make simple pneumatic circuits to solve specific problems. 5.5.1.16 mount pneumatic components accurately to achieve the intended power transmission. 5.5.1.17 demonstrate an awareness of potential work hazards when working with pneumatic devices.

6. TOOLS AND PROCESSES

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
6.1 Measuring and marking out <u>Rule</u> – metre, steel, carpenters folding and tape <u>Squares</u> – combination, engineer’s mitre, try and centre <u>Calipers</u> – external, internal, odd leg and vernier <u>Gauges</u> – marking, mortice, cutting <u>Punches</u> - centre and dot, bell Micrometer Scriber Sliding bevel Spirit level Spring dividers Wing compasses Marking knife Surface plane Surface gauge	6.1.1 acquire and apply knowledge of measuring and marking out tools and processes.	6.1.1.1 identify and illustrate measuring and marking out tools. 6.1.1.2 Label the parts of measuring and marking out tools. 6.1.1.3 handle measuring and marking out tools safely. 6.1.1.4 care for measuring and marking out tools. 6.1.1.5 measure and test materials accurately. 6.1.1.6 show the importance of datum surfaces and datum points. 6.1.1.7 find centres of round bars 6.1.1.8 mark out wood, metals and plastics using appropriate tools. 6.1.1.9 Use materials such as engineer’s blue, wet chalk, copper sulphate solution to prepare metal surfaces for marking. 6.1.1.10 Use lines such as construction lines, centre lines and gauge lines appropriately. 6.1.1.11 prepare and use a template and jigs where necessary.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
<i>Vee block</i> <i>Angle plate</i> <i>Engineer's blue</i> <i>Wet chalk</i> <i>Copper sulphate solution</i> <i>Wax crayon</i> <i>Felt pen</i>		
6.2 Saws and sawing <i>Abrasive saw</i> <i>Compass saw</i> <i>Coping saw</i> <i>Cross-cut saw</i> <i>Dovetail saw</i> <i>Gents saw</i> <i>Hacksaw</i> <i>Hole saw</i> <i>Jig saw</i> <i>Junior hacksaw</i> <i>Panel saw</i> <i>Pad saw</i> <i>Piercing</i> <i>Rip saw</i> <i>Saw set plier</i> <i>Scroll saw</i> <i>Tenon Saw</i>	6.2.1 acquire and apply knowledge of saws and sawing	6.2.1.1 identify and illustrate the prescribed saws. 6.2.1.2 label the parts of the prescribed saws. 6.2.1.3 demonstrate an understanding of the principles of sawing including holding the saw , supporting work, stance, strokes, starting and finishing a cut. 6.2.1.4 safely use a range of saws for straight and curved cuts including the choice of blade type, saw teeth and sizes to suit different types of materials.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
6.3 Planes and planing <i>Block plane</i> <i>Combination plane</i> <i>Jack plane</i> <i>Plough plane</i> <i>Rebate plane</i> <i>Router plane</i> <i>Smoothing plane</i> <i>Spokeshaves</i>	6.3.1 acquire and apply knowledge of planes and planing.	6.3.1.1 identify and illustrate the prescribed planes. 6.3.1.2 label the parts of the prescribed planes. 6.3.1.3 demonstrate an understanding of the principles of planing wood including sharpening, setting, stance and grip. 6.3.1.4 safely use prescribed planes appropriately for planing wood to size, end grain, and edges of manufactured boards. 6.3.1.5 plane edges of acrylic to specified requirements. 6.3.1.6 use spoke-shaves to shape inside and outside curves of wood.
6.4 Files and Filing <i>File card</i> <i>Flat file</i> <i>Flat surform</i> <i>Four-square file</i> <i>Half round file</i> <i>Hand file</i> <i>Needle files</i> <i>Rasp</i> <i>Round file</i> <i>Round surform</i> <i>Three-square file</i> <i>Warding file</i>	6.4.1 acquire and apply knowledge of files and filing.	6.4.1.1 identify and illustrate the prescribed files. 6.4.1.2 label the parts of the prescribed files. 6.4.1.3 demonstrate an understanding of the principles of filing in relation to types of tooth, grades or cuts and lengths. 6.4.1.4 safely use a range of files for cross, draw and straight filing including holding, supporting, stance and cleaning.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
6.5 Drills and drilling <i>Auger bit</i> <i>Awl</i> <i>Bradawl</i> <i>Breast drill</i> <i>Centre bit</i> <i>Centre drill</i> <i>Countersink drill</i> <i>Expansive bit</i> <i>Flat bit</i> <i>Forstner bit</i> <i>Hammer drill</i> <i>Hand drill</i> <i>Masonry drill</i> <i>Press drill</i> <i>Ratchet brace</i> <i>Twist drill</i>	6.5.1 acquire and apply knowledge of drills and drilling.	6.5.1.1 identify and illustrate the prescribed drilling and boring tools. 6.5.1.2 label the parts of the prescribed drilling and boring tools. 6.5.1.3 demonstrate an understanding of the principles of drilling as it relates to holding, supporting, stance, cutting action and feed. 6.5.1.4 safely use the brace to bore shallow, deep and through holes in wood. 6.5.1.5 set up the ratchet mechanisms for use in confined spaces. 6.5.1.6 safely use the pillar drill including changing the drill speed and point angles to suit different materials. 6.5.1.7 set drill speed to suit different materials and drill bit sizes.
6.6 Chisels and chiselling <i>Bevel edge chisel</i> <i>Cross-cut cold chisel</i> <i>Diamond p. Cold chisel</i> <i>Round nose cold chisel</i> <i>Paring chisel</i> <i>Firmer chisel</i>	6.6.1 acquire and apply knowledge of chisels and chiselling	6.6.1.1 identify and illustrate the prescribed wood and metal chisels. 6.6.1.2 label the parts of the prescribed chisels. 6.6.1.3 demonstrate an understanding of the principles of chiselling wood including paring, chopping and gouging. 6.6.1.4 demonstrate an understanding of the principles of chiselling metals including cutting, shearing and chipping.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
<i>Firmer gouge</i> <i>Flat cold chisel</i> <i>Mortise chisel</i> <i>Paring gouge</i>		6.6.1.5 safely use appropriate wood chisels for removing waste, cleaning up and finishing off joints. 6.6.1.6 safely use appropriate cold chisels for removing waste, cleaning up and finishing off joints.
6.7 Shears and shearing <i>Bench shear</i> <i>Scissors</i> <i>Straight snip</i> <i>Curved snip</i> <i>Universal tin snips</i> <i>Guillotine</i>	6.7.1 acquire and apply knowledge of shears and shearing.	6.7.1.1 identify and illustrate the prescribed shears. 6.7.1.2 label the parts of the prescribed shears. 6.7.1.3 demonstrate an understanding of the principles of shearing sheet materials. 6.7.1.4 safely use appropriate shears to cut materials to size.
6.8 Forming, casting and moulding <i>Casting –cope and drag, casting sand, crucible furnace and pot, leather glove and pouring ring.</i> <i>Cold casting – Latex and Vina mould</i> <i>Folding bars</i> <i>Line bender</i> <i>Pipe bender</i> <i>Vacuum former</i> <i>Formers</i>	6.8.1 acquire and apply forming, moulding and casting processes.	6.8.1.1 identify and illustrate the prescribed forming, moulding and casting tools. 6.8.1.2 label the parts of the prescribed forming, moulding and casting tools. 6.8.1.3 bend sheet metals using folding bars and soft faced hammers or mallets. 6.8.1.4 show an understanding of the sheet metal press forming processes. 6.8.1.5 bend acrylic into different forms using a line bender. 6.8.1.6 demonstrate an understanding of the following methods of forming plastics: laminating, plastic memory, press forming, vacuum forming, drape forming, casting, blow moulding, imprinting, extrusion and injection moulding. 6.8.1.7 vacuum form sheets of thermoplastics including making the pattern moulds. 6.8.1.8 use the principles of laminating for forming wood. 6.8.1.9 shape metal tubes using a pipe bender. 6.8.1.10 use the principles of sand casting including the preparation of patterns and moulds to produce aluminium products.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
6.9 Turning and shaping <u>Wood lathe</u> <i>Driving centre</i> <i>Tailstock centre</i> <i>Screw centre</i> <i>Fork centre</i> <i>Round nose gouge</i> <i>Square nose gouge</i> <i>Skew chisel</i> <i>Parting tool</i> <i>Shell type auger bit</i> <i>Face plate</i> <i>Scrapping tool</i> <i>Tool rest</i> <u>Centre lathe</u> <i>CNC lathe</i> <i>CNC milling machine</i> <i>Three-jaw chuck</i> <i>Four-jaw chuck</i> <i>Face plate</i> <i>Tailstock centre</i> <i>Headstock centre</i> <i>Right-hand knife tools</i> <i>Left-hand knife tools</i> <i>Round nosed tools</i> <i>Parting tools</i>	6.9.1 acquire and apply knowledge of turning and shaping materials.	6.9.1.1 identify and label the main parts of a wood and a centre lathe. 6.9.1.2 demonstrate an understanding of the principles of wood, metal and plastic turning processes. 6.9.1.3 safely use wood lathe for turning between centres, inner and outer faceplate work and long boring. 6.9.1.4 safely use centre lathe for parallel turning, facing off and the appropriate use of lubricants and cutting fluids. 6.9.1.5 determine the types of turning tools in relation to the material being machined. 6.9.1.6 select the correct cutting speed for mild steel, aluminium, brass and nylon. 6.9.1.7 choose the correct lathe speed for knurling, parting, centre drilling, drilling and using form tools. 6.9.1.8 demonstrate an understanding of the principles of computer numerically controlled (CNC) machines and their industrial applications. 6.9.1.9 safely use CNC lathe and milling machine to produce identical components. 6.9.1.10 safely use milling machines to make products.

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
<p><i>Form tools</i></p> <p><i>Cutting fluids</i></p> <p><i>Taps and dies <u>Milling machine</u></i></p> <p><i>Horizontal</i></p> <p><i>Verical</i></p>		
<p>6.10 Joining and fabricating</p> <p><u>Anvil</u></p> <p><u>Glue gun</u></p> <p><u>Hammers</u> – ball – pein, claw, club, sledge cross-pein, planishing and pin.</p> <p><u>Mallets</u> – bossing, tinman’s carpenter’s rawhide head, and rubber.</p> <p><u>Pincers</u></p> <p><u>Pliers</u> – combination, electrician, eyeletting, flat nose, long nose and side cutter</p> <p><u>Nail punch</u></p> <p><u>Revolving punch</u></p> <p><u>Riveting tools</u> – pop riveter, rivet set and snap.</p>	<p>6.10.1 acquire and apply knowledge of joining and fabricating materials.</p>	<p>6.10.1.1 identify the prescribed tools used for joining materials.</p> <p>6.10.1.2 use permanent, temporary and movable methods of joining materials.</p> <p>6.10.1.3 use the principles of taps and dies to join materials.</p> <p>6.10.1.4 join sheet metals using soft soldering and brazing including the correct application of fluxes, filler rods and temperature.</p> <p>6.10.1.5 join sheet metals using seam, lap and corner lap joints.</p> <p>6.10.1.6 select the appropriate wood joints when joining wood to wood. These include: <u>Butt</u> – simple, lap mitre and dowel. <u>Edge</u> – rubbed and glued, tongue and groove, loose tongue, and dowel. <u>Housing</u> - through, stopped. <u>Dovetail</u> – simple and lapped <u>Halving</u> – tee, cross, corner and dovetail <u>Bridle</u> – tee, corner and angled. <u>Mortice and tenon</u> – through, stopped.</p> <p>6.10.1.7 use appropriate nailing methods including dovetail, staggered and clinched nailing to join wood to wood and other materials to wood.</p> <p>6.10.1.8 choose appropriate construction techniques such as carcass, slab, stool and flat.</p> <p>6.10.1.9 join sheet metals using pop, snap, flat, and countersunk rivets, join materials using screws, nuts, bolts, washers, self-tapping and machine screws.</p> <p>6.10.1.10 join metals using oxyacetylene, electric arc and MIG welding.</p>

TOPICS	General objectives	Specific Objectives
	Candidates should:	Candidates should be able to:
<p><u>Screwdrivers</u> – Electrician, flat, Phillips and Pozidriv.</p> <p><u>Spanners</u> – adjustable, open and ring</p> <p><u>Tap and die set</u></p> <p><u>Tongs</u></p> <p><u>Wrenches</u> – mole, pipe, Stillson, and twisting.</p> <p><u>Welding</u> – arc, MIG and gas.</p>		<p>6.10.1.11 join plastics using heated tool and hot air welding processes.</p> <p>6.10.1.12 join materials using adhesives and knock down fittings.</p>
<p>6.11 Holding tools</p> <p>Woodworker's bench</p> <p>Woodworker's vice</p> <p>Engineer's bench</p> <p>Engineer's vice</p> <p>Hand vice</p> <p>Machine vice</p> <p>G-cramp</p> <p>Sash cramp</p> <p>Mitre cramp</p> <p>Speed cramp</p> <p>String cramp</p> <p>Toolmaker's clamp</p> <p>Vee block clamp</p> <p>Bench holdfast</p> <p>Bench hook</p> <p>Bench stop</p>	<p>6.11.1 acquire and apply knowledge holding and assembling work using holding tools.</p>	<p>6.11.1.1 identify holding tools and devices.</p> <p>6.11.1.2 safely use appropriate holding tools when working on materials.</p> <p>6.11.1.3 use appropriate holding tools when assembling products.</p> <p>6.11.1.4 care for holding tools and devices.</p>

6.12 Finishing materials	6.12.1 acquire and apply knowledge of finishing materials.	6.12.1.1 select appropriate aesthetic and functional finishes for particular materials. 6.12.1.2 recognise the need to use appropriate finishes and their solvents to protect materials against decay and corrosion. 6.12.1.3 prepare the surfaces of materials using the appropriate abrasives and cleaning up techniques including the use of buffing machine. 6.12.1.4 apply different finishing techniques on wooden products including staining, painting, varnishing and pyrography. 6.12.1.5 apply lacquer, paint and plastic coating to metal products. 6.12.1.6 demonstrate an understanding of the principles of electroplating. 6.12.1.7 care for finishing equipment.
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6. OTHER INFORMATION

6.1 GRADING AND REPORTING

BGCSE results are reported on a scale of A* – G, A* being the highest and G the lowest. Ungraded (U) indicates that the candidate's performance fell short of the standard required for grade G. Ungraded (U) will be reported on the statement of results but not on the certificate. The letters Q (result pending) and X (no result) may also appear on the statement of results.

6.2 GRADE DESCRIPTORS

Grade descriptions indicate the overall levels of achievement expected of candidates for the award of particular grades. The grades awarded will depend upon the extent to which the candidate has met the Assessment Objectives.

Grade A

Candidates should be able to:

- identify and minimise/control work hazards in the workshop;
- describe first aid techniques in treating minor injuries;
- justify the selection and use of materials;
- identify a problem from a situation and use a wide range of media to communicate design ideas to arrive at a design solution;
- communicate ideas in a concise, thorough and detailed manner using a wide range of presentation techniques;
- use suitable construction techniques and good flow of manufacturing processes as well as demonstrating good making skills with consideration of safety aspects and a suitable finish.

Grade C

Candidates should be able to:

- identify general safety precautions and possible work hazards in the workshop;
- state simple first aid techniques in treating minor injuries;
- make appropriate selection and use of materials;
- identify a problem from a situation and use a range of media to communicate design ideas in order to arrive at a design solution;
- clearly communicate ideas with some aspects of presentation techniques;
- use appropriate construction techniques and a flow of manufacturing processes as well as demonstrating average making skills and some consideration of safety aspects and appropriate finish.

Grade E

Candidates should be able to:

- list general safety precautions in the workshop;
- list basic first aid techniques;
- show basic knowledge in choice and use of materials;
- identify a problem from a given situation and use simple forms of communication to arrive at a solution;
- communicate ideas using limited presentation techniques;
- use limited construction techniques and manufacturing processes, making skills, as well as limited safety consideration and finishing techniques.

7. COURSEWORK

7.1 Introduction

The main purpose of coursework is to assess problem solving and manipulative skills. This is done through a thematic approach, whereby a general theme is presented to the candidates at the end of term 3 of Form 4. Candidates are required to start the project at the beginning of the first term of their final year and complete it by mid-October of the same year.

Candidates are required to follow a problem solving approach known as The Design Process to show their thought process as well as demonstrating manipulative skills by making the designed product.

There are two parts to the project:

Part A - Design Portfolio

Part B - Product Realisation

7.2 Part A – Portfolio Design

The portfolio is to be A3 size format and should consist mainly of illustrations and drawings, supplemented where necessary with written notes. Photographs may be included where helpful. Pages should be numbered and a list of contents, referenced with page numbers, included. The portfolio should include the following sections:

1. List of contents

This must include titles and page numbers of the whole portfolio.

2. Theme analysis

General analysis and interpretation of the Theme. Identify and briefly analyse a range of products that are used in the context of the theme.

3. Situation

Statement of the situation identified by the candidate derived and linked to the theme. The statement must **not** be combined with the problem.

4. Problem

A clear statement of the problem to be solved without including possible solutions. It must be derived from the situation.

5. Brief

An identified design task described in relevant terms addressing the problem. Candidates must **not** state the name of the product to be made.

6. Specification

A design specification that will set the parameters and limitations. These must be itemised requirements to be met by the solution.

7. Exploration of ideas

Exploration of a range of ideas/solutions in meeting the design brief and specification.

8. Development of chosen solution

Detailed development of the selected idea, including shape and form, materials and constructions to be used. This should also include a rendered presentation drawing of the final design in any pictorial form.

9. Working drawing (s)

Orthographic Drawing(s) of the intended solution must conform with the International Standard Organisation (ISO) . Part drawings and developments can be used for more complicated solutions. Candidates should indicate whether the product is a scale model or full size.

10. Production plan

Identified sequential stages and processes with consideration of at least 2 of the more complex tasks to be used in the construction of the solution. Candidates are also expected to show a material list and a time chart.

11. Communication

Candidates must show clearly a range of graphic communication skills including appropriate use of colour as well as good written communication skills throughout the portfolio. This should also include portfolio organisation.

7.3 Part B – Product Realisation

12. Manufacturing skills

Making of the product should involve and display a range of skills learned. It can be made from a single material or a range of appropriate materials.

Candidates are advised to avoid large projects as they may affect the quality and/or cost of the product.

13. Testing and Evaluation

This will be a report, based mainly on how the product matches the design requirements as identified in the specification . There should be evidence of testing to check if the product solves the problem. Other sections of the portfolio should reveal the ongoing evaluation by the candidate as the design was being developed, by showing the basis of decisions made. Candidates are also expected to show the good and bad points of their design. Candidates should indicate and justify changes made during realisation. They should indicate any possible modifications for improvement if they were to make it again.

7.4 Teachers' Notes

Since this is a continuous assessment project teachers are expected to continue teaching and to support the candidates through advice and guidance throughout the project. Decisions and judgements are to be made by the candidates with teachers' approval. Practical work must be done by candidates, with guidance from the teacher. All materials are to be supplied by the school.

7.5 Portfolio Presentation

The complete folio must be bound using appropriate methods such as:

- Spiral binding
- Tape and Staple binding
- Thermal binding
- Slide binders
- Velo binding strips

7.6 Coursework Assessment Procedures

This will be done using coursework Assessment Objectives and Marking Scheme. There are two stages involved in assessing coursework:

A. Marking

(i) Formative assessment

Marking will take place in the centre throughout the development of the project according to the guidelines in the *Coursework Assessment and Marking Scheme* which will be issued as a separate document.

(ii) Summative assessment

To ensure consistency within a centre, teachers must conduct a standardisation meeting prior to marking. This exercise should include:-

- (a) selection of a representative sample of the projects
- (b) establishing a common understanding of the marking scheme
- (c) team marking

Centre marking must be done in teams so that markers can standardise each other

B. Moderation

(i) Internal

After team marking, teachers marks must be internally moderated by a senior member of staff supervised by a Senior Teacher I or Subject Co-ordinator.

(ii) External

To ensure consistency across centres, the internal assessments will be externally moderated.