GCE MARKING SCHEME

DESIGN AND TECHNOLOGY
AS/Advanced

SUMMER 2015

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCE DESIGN AND TECHNOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

GCE DESIGN & TECHNOLOGY - DT1 PRODUCT DESIGN

SUMMER 2015 MARK SCHEME

SECTION A

Q.1 Products may have pre finished surfaces produced during manufacture or have surface finishes applied by the consumer.

(a) Name a product which has a finished surface produced by the manufacturer, the type of finish and two reasons why it is appropriate. [4]

(b) Name a product which the surface applied finished by the consumer, the type of finish and two reasons why it is appropriate. [4]

(a) Product and finish applied by manufacturer: range of electrical product cases (textured as part of moulding), textile products (use of specialist dyes/fireproofing agents), agricultural products (galvanised).

Manufacturer Finish:

Name of product	One mark
Type of finish	One mark
Reasons for finish	Up to Two marks

Type of finish applied:
Heat treatment, galvanising, anodising, textured surfaces, e.g. knurling (to improve grip).

(b) Product and finish applied by consumer: furniture item (varnish), external timber products (stain/sealer), steel products (painted), textile products (which are dyed by the consumer)

Consumer finish:

Name of product	One mark
Type of finish	One mark
Reasons for finish	Up to two marks

The range of finishes may be to improve aesthetic, physical and functional characteristics giving the consumer choice.

Self finishing:
Paint, varnish, plating to provide colour, texture – applied to range of specific woods, metals.
Use of veneers.

Q.2 (a) Describe the main features of a high volume production system. [4]

(b) Explain four benefits of a high volume production system to the manufacturer. 4 x [1]

Features:
Products produced in quantity, can be supported by sub-assembly systems, components added along the assembly line, workers with specific tasks.

Up to four marks for a full description.

Benefits:
Increased sales of products, selling price is less, use of unskilled workforce, speed of production.

One mark for each benefit explained.

Q.3 Products that are certified by the *British Standards Institute* (BSI) have passed specific tests before use by the consumer.

Name four products that are certified and describe a specific test that each needs to pass. 4 x [2]

Safety Marks help consumers and traders to identify registered controlled goods. All registered controlled goods must be individually marked with the Safety Mark either on the product or packaging.

Products from: Child Safety Seats, Children's Toys, Cots, Fireguards, High Chairs, Pushchairs and Prams, Safety Gates, Smoke Alarms, motorcycle helmets, upholstery, specific electrical items, seat belts/harnesses.

Description of specific safety test, based on: insulation test, impact test, toxic tests, strength tests.

Two marks for each product - stated and described test, i.e. a child's safety seat undergoes impact testing which is simulated at a centre to ensure complete safety in the event of an accident.

Q.4 Materials may be classified as natural, synthetic or regenerated.

For any two of these name a specific material, its particular properties and application. 2 x [4]

(a) Natural: e.g. from copper, oak, pine, linen, silk, silver, wool, etc.

(b) Synthetic: e.g. acrylic, cellophane, epoxy resin, polyester, polypropylene, etc.

(c) Regenerated: e.g. from paper, viscose, MDF, chipboard, block board or plastic based composites

Specific material - One mark for each	2
Property - Two marks for each	4
Application - One mark for each	2

Q.5 Product designers use information from both *primary research* and *secondary research* to inform their designing.

(a) Describe the kind of information identified through *primary research.* [4]

(b) Describe the kind of information identified through *secondary research.* [4]

(a) Primary Research: the collection of information personally (original contributions) from various sources (surveys, questionnaires, asking a client or user, going out and collecting data, testing, modelling).

Look for the candidates understanding of the term through what they describe as being identified as primary research. 4

(b) Secondary Research: the collection of background information which are usually easier to obtain (articles in publications, data sheets, web based research, databases)

Look for the candidates understanding of the term through what they describe as being identified as secondary research. 4

Q.6 Explain the following terms:

(a) *Reverse Engineering* as used within design and production [4]

(b) *Concurrent Engineering* as used within product development. [4]

Explanation of terms (some responses may also outline benefits).

(a) Reverse Engineering (up to four marks):
- This is the process of discovering the technological principles of a product, device or system.
- An analysis of its structure and form.
- Take something apart and analyse its workings (mechanical, electrical or software).
- Product development can be accomplished more effectively and looks at constant product improvement.
- Above and below line features.

(b) Concurrent Engineering (up to four marks):
- Employs simultaneous, rather than sequential, processes.
- Completing tasks in parallel.
- Product development can be accomplished more efficiently and at a substantial cost savings.
- Concurrent engineering allows for design and analysis to occur at the same time, and multiple times, prior to actual deployment.
- Emphasises teamwork.
- Allows for employees to work collaboratively on all aspects of a project from start to finish.
- Reduces the time required to bring a new product to the market.

Q.7 (a) Explain the terms *qualitative* and *quantitative* performance criteria when drawing up a design specification. [4]

(b) For a named product specification, state two examples of *qualitative* performance criteria and two examples of *quantitative* performance criteria. 2 x [2]

Explanation of terms – up to four marks
Both quantitative and qualitative performance criteria refer to the requirements as set out in the specification (which is then used during the evaluation stage):

Responses may refer to function, aesthetics, economics (value), human interface (ergonomics), personal appeal, reliability, life-cycle of the technology, timing (seasonality, market, billing, etc.) personal resource availability, energy resources required for product use, etc.

Two examples for each:

Example: **Children's Board Game**

A qualitative performance
- *i. the game must be suitable for its target market (i.e. age range between 3-5)*
- *ii. the material used to manufacture the components must be hygienically suitable.*

B quantitative performance criteria
- *i. the game must be suitable for production in batch.*
- *ii, the weight and size of each component must be appropriate to the target market.*

Q.8 With reference to the production of a particular product or material, explain what is meant by quality control together with its importance to the manufacturer. [8]

Quality control is a process that is used to ensure a certain level of quality in a product or material. It involves thoroughly examining and testing the quality of products or materials. The basic goal of this process is to ensure that the products or materials that are provided meet specific requirements and characteristics, such as being dependable, satisfactory and safe.

Companies that engage in quality control typically have a team of workers who focus on testing a certain number of products or materials. The products or materials that are examined are usually chosen at random. The goal of the quality control team is to identify products or materials that do not meet a company's specified standards of quality. If a problem is identified, the job of a quality control team or professional might involve stopping production until the problem has been corrected.

Responses based on:

- A description of the method of monitoring and reaching standards through testing.
- Reference to materials, tolerances, quality of appearance and surface finish.
- Target setting which can be measured.
- Meeting consumer and environmental needs and expectations.
- Checks at points for accuracy and safety of product or component – so that it meets consumer and environmental expectations.
- Quality control methods: dimensional accuracy (tolerances), quality of materials (visual marks or blemishes) appearance and finish, durability.
- Dimensional accuracy may be checked with a gauge or measuring tool (micrometer, Vernier, etc.).

SECTION B

Section B involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

Level 1 0-10 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication
Level 2 11-16 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 17-23 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling
Level 4 24-30 marks	• The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION B

Q.9 With reference to at least two different products, explain why both styling and image creation are important in product development, commenting on the importance of these factors to the consumer. [30]

Responses would need to acknowledge the importance of the statement to consumers and manufacturers in order to maintain product development in the market.

Responses may refer to the importance of style and image creation in the development stage:

References to designers responding to *changing styles* and *needs of consumers* i.e. related to seasonal colour trends in fashion, new shaped in products possible through new technologies/components. The needs of various consumers could also be highlighted here (not within mass markets).

Fashion 'trends' – image and style trends to match specific consumer groups (children, teenagers, adults).

Responses may also refer to consumer needs and results from market research in reference to the continuation of product development.

Responses will use the points to illustrate how the designer is driven or influenced by the consumer and market research (and also how designers influence the consumer with new styles or technologies).

Specific products will need to be used to illustrate the importance of the factors.

Q.10 Technological developments have had an inevitable impact on the design and manufacture of products.

Explain how technological developments have improved the manufacture, function and appeal of named products. [30]

Detailed ranges of products are required to illustrate the developments in technology, which have had an impact on design and development:

- Manufacture – the effect of volume production, simplicity in making/manufacturing, new circuit production, new ways of manufacturing.
- Function – the development of 'multi-functional' products (and their availability to mass markets.
- Appeal – the sophisticated use of research and promotional activities which try to ensure product success.

Responses may refer to changes over time, and how a named product has changed either over a short or longer period of time (which can be historical - where responses may also refer to changes in style, tastes and a person's changing needs).

Responses may highlight how the product has been enhanced through using new or improved materials, manufacturing methods and innovation (how the product has improved in its function).

Q.11 Designers create products using their knowledge and understanding of materials, production methods and market needs.

Discuss the validity of this statement in relation to a specific product or range of products. [30]

The importance of the development of knowledge and understanding of materials, production methods and market needs in successful designing must be central to the response.

Responses must offer reasons how and why designers use their knowledge (of materials, production methods and market needs):

Materials
In order to design successfully designers must have a thorough knowledge in terms of range, properties and characteristics of materials and availability.

Production methods
Knowledge of production methods ensuring the most efficient methods are used (in a cost effective and environmentally efficient way as possible).

Market needs
Designer must be aware of their market needs and potential sales.

Responses may then focus on a range of contexts such as fashion design, engineering/automotive design, furniture design, jewellery design, etc.

GCE DESIGN & TECHNOLOGY - DT1 FOOD TECHNOLOGY

SUMMER 2015 MARK SCHEME

SECTION A

Q.1 (a) State one finishing technique that could be applied to a named food product. [2]

(b) Describe three different reasons for using this technique to improve the named food product. 3 x [2]

(a) Finishing techniques are used in food production for both aesthetic and functional reasons, candidates should select one technique and describe its application, e.g. glazing, browning, icing, piping, colouring, coating with breadcrumbs, enrobing.

Candidates could describe how

- Glazing adds a shiny finish to a pastry product and is added before cooking, e.g. sausage rolls, raw pastry is brushed with beaten egg which co-agulates on heating and leaves a shiny film, contributes to the nutritional value of protein.
- Browning, e.g. dextrinisation when baked the starch in bread, cakes, pastry and biscuits changed to dextrin and turns a light golden brown colour. Using only egg yolk for glazing gives a darker brown colour for glazing than when whole egg is used.
- Colouring, e.g. caramelisation – sugar turns brown when heated, e.g. baked products such as cakes or sweet pastry, or in boiled sugar such as toffee based products and caramels.
- Icing can add colour, flavour and texture to cakes. Candidates could describe a specific icing type (royal icing / fondant icing) and how it is made. Icing could be applied by manufacturers using CAD/CAM – printed icing.
- Coating with breadcrumbs:-
  - adds texture, improves appearance, colour and flavour
  - could add fire (Oats) to improve nutritional value
- Enrobing:
  - chocolate/aesthetic appeal/extends shelf life
  - cost could be affected (luxury product)

(b) Describe three reasons for using the finishing technique named in (a). The finish stated may be used to improve aesthetic value and palatability (taste, texture, colour, aroma or smell and overall appeal) of a named product giving the consumer choice. Glazing, browning, icing or other decorative techniques such as piping (including icing produced using CAD/CAM techniques/processes) and colouring are examples of finishing techniques used by food manufactures to enhance appearance and palatability of the product.

3 x 2 marks for each reason

Q.2 (a) Describe the main features of a high volume (mass) production system in the food industry. [4]

(b) Explain four benefits of a high volume (mass) production system to the manufacturer. 4 x [1]

Features

- Food products produced in large quantities quickly and efficiently.
- Large scale specialist equipment is used for processes such as cutting, mixing, moulding, wrapping, and packaging, e.g. specialist equipment developed such as to cut lattice pie tops for pastry pies.
- Can be supported by sub-assembly systems.
- Components added along the assembly line.
- Workers with specific tasks which are sequenced into a production line.

Up to 4 marks for a full description.

Benefits

- Increased sales of products.
- Selling price is less – large numbers of food products produced keeps unit costs low.
- Use of unskilled workforce.
- Speed of production.
- Low ratio of workers to the number of products produced.
- Raw materials and components are purchased in bulk.
- Consistent quality.
- Less risk of human error (less waste).

One mark for each benefit.

Q.3 Copyright, patents and design rights are all Intellectual Property Rights granted by the Patent Office.

Describe two of these rights in relation to specific food products. 2 x [4]

Product must be named / clear reference to selected point and relevance discussed.

Copyright - controls the way certain types of material can be exploited, it comes into effect as soon as something that can be protected is created, usually copyright lasts 70 years after the death of the creator, owning a copyright prevents illegal copies being made: often companies try to 'copy' foods but are unable to exactly copy due to original recipes having a copyright, e.g. Jaffa cakes / Heinz baked beans.

Patents -. A patent is a bargain between the state and the inventor. The state offers a monopoly in return for a full description of the invention, which is published. When patent is granted for a new design, the inventor has 20 years (in the UK) to capitalise on it free from competition. The invention is the property of the designer, it can, therefore, be bought, sold or rented. Many patents are for incremental improvements in known technology (NOT for radical designs) e.g. Quorn ; new food ingredients, additives or flavours can also be patented.

Patents protect the way things work, what they do, how they do it, what they are made from, how they are made**,** e.g. one enterprising (and anonymous) designer is credited with designing a special rivet which could *pull* and *tear.* Coca-Cola used the idea paying the designer 0.1cent per 'ring pull'. For the next 20 years Coca-Cola made on average 1.4 million cans/day worldwide!

Design Rights - Design Right protects the shape or configuration of articles for 10 years after its creation. Design right is property, it can be bought, sold or licensed. Does not apply to surface decoration. Recipe for Coca-Cola or the ingredients for KFC are examples.

Q.4 New food materials have been developed which have specific properties and characteristics.

Name two such food materials and describe their particular properties, characteristics and use. 2 x [4]

Specific food materials named x 2 (Quorn / single cell protein / TVP / Tofu / smart materials, e.g. modified starches, functional foods, fat replacers, sweetener Saccharin, encapsulated ingredients

Describe properties and give example of use.

Quorn – made from mycoprotein, can be processed as mince, fillets or chunks, similar in taste and texture to meat. Suitable for a vegetarian diet, low in fat, contains some dietary fibre, popular in ready meal market, e.g. sweet and sour dishes, curries and savoury casseroles. (Vegans cannot eat mycoprotein because egg white is used to bind it together).

Tofu – soya milk curd, can be made by curdling soya milk and calcium sulphate. Soya curds are pressed and the firm curd that remains is called Tofu, should be eaten 'fresh', can be used for many diff dishes including Tofu burgers / stir-fry and in desserts such as ice cream. Tofu absorbs flavours.

TVP – is made from soya bean flour which had its oil removed. The soya flour is mixed to a dough, water added and extruded in a process that cooks the dough and gives it its fibrous meat like structure. TVP is used in vegetable burgers, burger mixes, sausages / curry mixes. TVP is a high biological protein, often enriched with vitamins and minerals, soya is fortified with Vitamin B12, low in fat, reasonable source of fibre.

Modified Starch – non-food starch that has been modified by chemical and physical means to increase the stability of food against excessive heat, acid and freezing, change the texture of a product or lengthen or shorten the gelatinisation time of a product when it is made in a factory. Some modified starches thicken liquids without heat (save cooking time). Used in puddings / instant desserts and Modified starch is used in 'cup-a-soups' to improve mouth-feel, thicken the drink/sauce with the addition of boiled water, and blend uniformly with no lumps. Another example is the noodles in 'pot noodles' are pre-gelatinised, so boiled water will re-heat and 'cook' them.

Functional foods – term used to describe any food that contains an ingredient that gives food health promoting properties above its usual nutritional value. The two most popular functional foods are cholesterol lowering spreads and probiotic yogurts or drinks. Probiotic drinks are designed to improve the health of the large bowel and cholesterol lowering spreads are used to help people with raised blood and cholesterol levels that are following a healthy diet. **Encapsulation ingredients**, e.g. encapsulated flavours in confectionery, e.g. Jellybeans' use encapsulated flavours for enhanced sensory appeal and also specially formulated 'sports' bars are fortified with encapsulated nutrients.

Q.5 Food product designers use information from both primary and secondary research to inform their designing.

(a) Describe the kind of information identified through primary research. [4]

(b) Describe the kind of information identified through secondary research. [4]

Primary Research: the collection of information personally (original contributions) from various sources (surveys, questionnaires, asking a client or user, going out and collecting data, testing, modelling and taste testing).

Look for the candidates understanding of the term through what they describe as being identified as primary research.

Secondary Research: the collection of background information which is usually easier to obtain (articles in publications, data sheets, web based research, databases).

Look for the candidates understanding of the term through what they describe as being identified as secondary research.

Q.6 Explain how stable foams and emulsions are formed and used in the manufacture of named food products. [8]

State clear, good examples for both stable emulsions and foams.

Emulsion examples could be mayonnaise / Italian dressings/ice cream/ salad cream/ milk.

Raw cake mixtures, e.g. Swiss roll or sponge cake / meringues / milk foams / whipped cream and marshmallows are examples of foams.

An emulsion is formed when two liquids that will not normally mix and mixed together; to maintain a stable emulsion, e.g. in the manufacture of margarine, in the mixing of a rich cake mixture or in the making of a mayonnaise, the addition of an emulsifier is necessary. Egg yolk is an important emulsifier because it contains a high proportion of the emulsifier 'lecithin'. Commercially added lecithin (E322) is mostly obtained from soya beans. The ability of egg yolk to emulsify fat or oil and water is also used in making oil dressings and butter sauces such as Hollandaise sauce.

The ability of eggs to form a foam is used for lightening mixtures, whole egg can be whisked to hold air and act as a raising agent for whisked sponge cakes, soufflé and mousse. Foams also used in flourless cakes. Egg whites whisked alone hold even larger quantities of air and is used in meringues and also where the beaten egg is then folded into mixtures such as in a soufflé. When making meringues, the whisked egg protein forms a protective layer around the air bubbles, this stabilises the foam, when heated the air bubbles grow, the egg white protein coagulates to make a solid network. This results in the foam changing from a liquid into a solid and a permanent meringue is formed, this is an irreversible change.

Q.7 (a) Explain the terms qualitative and quantitative performance criteria when drawing up a design specification for a food product. 2 x [2]

(b) For a named food product specification, state two examples of *qualitative* performance criteria and two examples of *quantitative* performance criteria. 2 x [2]

Explanation of terms – up to 4 marks

Both quantitative and qualitative performance criteria refer to the requirements as set out in the specification (which is then used during the evaluation stage). These will let the user know exactly how the product should look and taste

Responses may refer to function, aesthetics, economics (value), human interface (ergonomics), personal appeal, reliability, life-cycle of the technology, timing (seasonality, market, billing, etc.) personal resource availability, energy resources required for product use.

Two food related examples for each:

I **Qualitative** performance criteria – points could refer to the sensory qualities of the products (taste / appearance /flavour), specific details about storage, packaging / details about raw ingredients.

II **Quantitative** performance criteria – all should be measureable /size / weight / quantity / temperature.

Q.8 (a) Define the term quality control in the production of food products. [2]

(b) With reference to the production of a particular food product or material, explain how quality control is carried out and why it is important to the manufacturer. [6]

(a) Quality control is a process that is used to ensure a certain level of quality in a product or material. It involves thoroughly examining and testing the quality of products or materials. The basic goal of this process is to ensure that the products or materials that are provided meet specific requirements and characteristics, such as being dependable, satisfactory and safe. Examples such as procedures/controls set up to ensure a product meets specific criteria during and after manufacture such in bread making batch testing and inspection on completion or checks

(b) Candidates must specify a particular food product or material. Comments could relate to regarding stock rotation / maintenance of equipment / correct amount of ingredients being used for each batch of products being made / packaging sealed and assembled correctly? / potential hazards (HACCP). Companies that engage in quality control typically have a team of workers who focus on testing a certain number of products or materials. The products or materials that are examined are usually chosen at random. The goal of the quality control team is to identify products or materials that do not meet a company's specified standards of quality. If a problem is identified, the job of a quality control team or professional might involve stopping production until the problem has been corrected. Taste testing may be part of the quality control.

Responses could also include:

- A description of the method of monitoring and reaching standards through testing.
- Reference to materials, tolerances, quality of appearance and finish.
- Meeting consumer and environmental needs and expectations.
- Checks at points for accuracy and safety of product or component – so that it meets consumer and environmental expectations.
- Quality control methods: dimensional accuracy (tolerances), quality of materials (visual marks or blemishes) appearance and finish.

No marks for Quality Assurance procedures.

SECTION B

Section B involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

Level 1 **0-10**	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 **11-16**	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 **17-23**	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 **24-30**	• The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION B

Q.9 With reference to at least two different food products, explain why both styling and image creation are important to the manufacturer in product development and to the intended target market. [30]

Responses may refer to the importance of style and image creation in the development stage:

(a) Designers responding to changing styles and needs of consumers.
(b) Fashion trends – image and style to match specific consumer groups.
(c) Consumer needs and results from market research.
(d) Nutritional claims or current findings.
(e) The power of advertising / social media
(f) Environmental factors / recycling.
(g) Economic issues / ref to current monetary.
(h) Technological developments.
(i) Media influences such as TV chefs / influence of bake off trending.

Responses will use the points to illustrate how the designer is driven or influenced by the consumer and market research (and also how designers influence the consumer with new styles or technologies).

Specific products will be used to illustrate the importance of the factors. **30 marks**

Q.10 Technological developments have had an inevitable impact on the design and manufacture of food products.

Explain how technological developments have improved the manufacture, function, and appeal of named food products. [30]

Improvement in the function of a product through:

(a) New or improved materials – use of smart foods could be used e. sports nutrition bars / (encapsulation), functional ingredients (use of probiotic drinks/ cholesterol lowing spreads), Quorn, hydrogenated fats, etc.
(b) New or improved component parts.
(c) Manufacturing methods / improved equipment, e.g. laser printing used to produce icing/decorations, depositors for quantity, use of CAM for operations, packaging methods, preservation, blast chilling, GM foods (size, shape and colour).

A detailed product is required to illustrate the developments in technology, which have affected this over time, how this named product has changed either over a short or longer period of time (which can be historically where responses may also refer to changes in style, tastes and people's needs).

Basically, description of how the product has been enhanced through using new or improved materials, manufacturing methods and innovation (how the product has improved in its function).

Q.11 Discuss how manufacturers exploit the properties of sugar to create desirable qualities and characteristics in a range of food products. [30]

Name products – state use of sugar within the production of the named products (e.g. caramelisation / preservation / aeration / moisture retention). Examples of where sugar is used to create desirable properties could include:

- Gluten development in bread making.
- Prevents development of gluten in cake and pastry mixtures giving a softer product after baking.
- Retains moisture and prevents baked products from becoming dry.
- Helps fat to incorporate more air in cake mixtures (increases volume).
- Enhancing of smoothness of ice cream.
- Tenderising of meat products.
- Delaying coagulation of egg protein in custards.
- Strengthening the protein of stiffly beaten egg white and helps the mixture to retain a high proportion of air (meringues).
- Acts as preservative in jams, marmalades and jellies.
- Used in a variety of cake decorations – glace / royal / fondant icings, etc.
- Preparation of sweets, e.g. toffee / fudge, etc.

Comments could also relate to recommended daily amounts, manufactures striving to reduce the sugar content of products but this has led to a higher fat content in some products.

Types/forms of sugar need verification to gain credit, e.g. caster sugar is used to create more air/volume in cake mixtures.

The use of sugar substitutes, e.g. saccharin or sorbitol, costs to the consumer and market trends could also be discussed.

GCE DESIGN & TECHNOLOGY - DT1 SYSTEMS AND CONTROL TECHNOLOGY

SUMMER 2015 MARK SCHEME

SECTION A

Q.1 Creating a time delay in a system can be achieved using microprocessor, electronic and pneumatic circuits.

With the aid of sketches describe two different methods of creating time delays in systems. 2 x [4]

Microcontroller system
The programme can use commands such as wait or pause to create a delay or create a conditional loop to pause the system for a set time or until a switch is pressed. For instance an entry delay for an alarm system, allows you 15 seconds after opening a door to reset the alarm before it is set off.

555 timer circuits
Use of the resistor to slowly charge up capacitor, built up voltage across capacitor triggering next stage.

Pneumatic cylinder circuit
Use of restrictor to slowly pressurise a reservoir, when pressure builds up in reservoir next stage is triggered.

Q.2 (a) Describe the main features of a high volume production system. [4]

(b) Explain four benefits of a high volume production system to the manufacturer. 4 x [1]

Features: products produced in quantity, can be supported by sub-assembly systems, components added along the assembly line, workers with specific tasks.

Up to four marks for a full description.

Benefits: increased sales of products, selling price is less, use of unskilled workforce, speed of production, etc.

One mark for each benefit.

Q.3 Products that are certified by the *British Standards Institute* (BSI) have passed specific tests before use by the consumer.

Name four products that are certified and describe the specific test that each needs to pass. 4 x [2]

Safety Marks help consumers and traders to identify registered controlled goods. All registered controlled goods must be individually marked with the Safety Mark either on the product or packaging.

Products: Child Safety Seats, Children's Toys, Cots, Fireguards, High Chairs, Pushchairs and Prams, Safety Gates, Smoke Alarms, motorcycle helmets, upholstery, specific electrical items, seat belts/harnesses.
Two marks for each safety mark

Specific safety test: insulation test, impact test, toxic tests, strength tests.

Two marks for each stated and described test.

Q.4 Plain bearings can be used in drive systems to support radial rotating shafts.

(a) Describe a plain bearing. [2]

(b) State two materials used for plain bearings and explain why they are suitable. 2 x [3]

Plain Bearing
A simple sleeve type bearing where the shaft rubs on the bearing surface. Friction is reduced by lubrication or by using materials which slide with little friction against each other.

Nylon, PTFE
Used in light duty applications such as toys, food mixers, etc. Low cost, simple manufacture, no lubrication required, quiet running.

Phosphor bronze
Used in small electric motor bearings for toys and hair dryers. Good load carrying bearing, not suitable for high speeds, no lubrication required, simple in construction.

White metal
Tin-lead or tin-copper alloys used with oil lubrications to give friction free bearings in combustion engines. White metal adapts to the shape of the shaft due to its softness.

Q.5 Product designers use information from both primary research and secondary research to inform their designing.

(a) Describe the information identified through primary research. [4]

(b) Describe the information identified through secondary research. [4]

Primary Research: the collection of information personally (original contributions) from various sources (surveys, questionnaires, asking a client or user, going out and collecting data, testing, modelling).

Look for the candidates understanding of the term through what they describe as being identified as primary research. 4

Secondary Research: the collection of background information which is usually easier to obtain (articles in publications, data sheets, web based research, databases)

Look for the candidates understanding of the term through what they describe as being identified as secondary research. 4

Q.6 Explain the following terms:

Reverse Engineering as used within design and production [4]

Concurrent Engineering as used within product development. [4]

Explanation of terms (some responses may also outline benefits).

Concurrent Engineering (up to four marks):

- Employs simultaneous, rather than sequential, processes.
- Completing tasks in parallel.
- Product development can be accomplished more efficiently and at a substantial cost savings.
- Concurrent engineering allows for design and analysis to occur at the same time, and multiple times, prior to actual deployment.
- Emphasises teamwork.
- Allows for employees to work collaboratively on all aspects of a project from start to finish.
- Reduces the time required to bring a new product to the market.
- Above and below line features.

Reverse Engineering (up to four marks):

- The process of discovering the technological principles of a product, device or system.
- Analysis of its structure and form.
- Take something apart and analyse its workings (mechanical, electrical or software).
- Product development can be accomplished more efficiently and at a substantial cost savings.

Q.7 (a) Explain the terms qualitative and quantitative performance criteria when used in a design specification. [4]

(b) Within the specification for a named product, state two examples of qualitative performance criteria and two examples of quantitative performance criteria. 2 x [2]

Explanation of terms – up to four marks.
Both quantitative and qualitative performance criteria refer to the requirements as set out in the specification (which is then used during the evaluation stage).

Responses may refer to function, aesthetics, economics (value), human interface (ergonomics), personal appeal, reliability, life-cycle of the technology, timing (seasonality, market, billing, etc.), personal resource availability, energy resources required for product use, etc.

Two marks examples for each:
I. *qualitative* performance
II. *quantitative* performance criteria

Q.8 With reference to the production of an electronic circuit for a particular product, explain what is meant by quality control and state why it is important to the manufacturer. [8]

Quality control is a process that is used to ensure a certain level of quality in a product or material. It involves thoroughly examining and testing the quality of products or components. The basic goal of this process is to ensure that the products or components that are provided meet specific requirements and characteristics, such as being dependable, satisfactory and safe.

Companies that engage in quality control typically have a team of workers who focus on testing a certain number of products or components. The products or components that are examined are usually chosen at random. The goal of the quality control team is to identify products or components that do not meet a company's specified standards of quality. If a problem is identified, the job of a quality control team or professional might involve stopping production until the problem has been corrected.

Responses based on:
- A description of the method of monitoring and reaching standards through testing.
- Reference to components, tolerances, quality of appearance and surface finish.
- Target setting which can be measured.
- Checks at points for accuracy and safety of product or component – so that it meets consumer and environmental expectations.
- Quality control methods: dimensional accuracy (tolerances), quality of materials (visual marks or blemishes) appearance and finish, durability.
- Automated visual inspection of circuits.
- Random checking of components.
- Function testing of circuits on test rigs.
- Dimensional accuracy may be checked with a gauge or measuring tool (micrometer, Vernier, etc).

No marks for Quality Assurance procedures

SECTION B

Section B involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

Level 1 0-10 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication
Level 2 11-16 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 17-23 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling
Level 4 24-30 marks	• The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION B

Q.9 With reference to at least two different products, explain why both styling and image creation are important in product development, commenting on the importance of these factors to the consumer. [30]

Responses would need to acknowledge the importance of the statement to consumers and manufacturers in order to maintain product development in the market.

Responses may refer to the importance of style and image creation in the development stage:

References to designers responding to *changing styles* and *needs of consumers* i.e. related to seasonal colour trends in fashion, new shaped in products possible through new technologies/components. The needs of various consumers could also be highlighted here (not within mass markets).

Fashion 'trends' – image and style trends to match specific consumer groups (children, teenagers, adults).

Responses may also refer to consumer needs and results from market research in reference to the continuation of product development.

Responses will use the points to illustrate how the designer is driven or influenced by the consumer and market research (and also how designers influence the consumer with new styles or technologies).

Specific products will need to be used to illustrate the importance of the factors.

Q.10 Technological developments have had an inevitable impact on the design and manufacture of products.

Explain how technological developments have improved the manufacture, function and appeal of named products. [30]

Detailed ranges of products are required to illustrate the developments in technology, which have had an impact on design and development:

- Manufacture – the effect of volume production, simplicity in making/manufacturing, new circuit production, new ways of manufacturing.
- Function – the development of 'multi-functional' products (and their availability to mass markets.
- Appeal – the sophisticated use of research and promotional activities which try to ensure product success.

Responses may refer to changes over time, and how a named product has changed either over a short or longer period of time (which can be historical - where responses may also refer to changes in style, tastes and a person's changing needs).

Responses may highlight how the product has been enhanced through using new or improved materials, manufacturing methods and innovation (how the product has improved in its function).

11. Designers create products using their knowledge and understanding of electronic components, production methods and market needs.

Discuss this statement in relation to a specific product or range of products.
[30]

The importance of the development of knowledge and understanding of electronic components, production methods and market needs in successful designing must be central to the response.

Responses may then focus on a range of contexts such as hand held electronic products, engineering/automotive control, environmental control, toy design etc.

GCE DESIGN & TECHNOLOGY - DT3 PRODUCT DESIGN

SUMMER 2015 MARK SCHEME

SECTION A

Answer **three** *questions from this section*.
This section is designed to demonstrate your ***breadth*** *of knowledge in Product Design.*

Each question carries 8 marks.

Q.1 Explain the terms customer needs and customer wants, when making decisions about the design of products. 2 x [4]

- Customer needs are essential features of a product that have to be included if the product is to be purchased by the consumer e.g. the cyclone technology that differentiated the product from it's competitors.
- Customer wants are supplementary features which could be included as enhancement features e.g. aesthetic dealing in terms of the colour of motor cars.

Q.2 Explain what you understand by the term Computer Integrated Manufacturing (CIM) as a system used in volume production. [8]

- Computer -integrated manufacturing (CIM) is the manufacturing approach of using computers to control the entire production process.
- This integration allows individual processes to exchange information with each other and initiate further actions.]
- Through the integration of computers, manufacturing can be faster and less error-prone, although the main advantage is the ability to create automated manufacturing processes.
- CIM relies on closed-loop control processes, based on real-time input from sensors. It is also known as flexible design and manufacturing.
- Responses may refer to global manufacturing.

Q.3 Describe one benefit and one limitation of using the following sources of energy when manufacturing products. 4 x [2]

(a) fossil fuels;
(b) nuclear fuels;
(c) hydro generation;
(d) wind generation.

Note: Candidates may be given I mark for weak answers that refer to both benefits and limitations.

Fossil fuels

Benefits
- Fossil fuels are of great importance because they can be burned producing significant amounts of energy per unit weight.
- Natural gas, once flared -off as an un-needed by product of petroleum production, is now considered a very valuable resource.

Limitations
- Fossil fuels are non-renewable resources because they take millions of years to form.
- The production and use of fossil fuels raises huge environmental concerns.

Nuclear fuels

Benefits
- Stated estimates for fission fuel supply at known usage rates vary, from several decades to billions of years.
- The cost of making nuclear power, with current legislation, is about the same as making coal power, which is considered inexpensive.
- Nuclear power does not produce any primary air pollution or release carbon dioxide and sulphur dioxide into the atmosphere. Therefore, it contributes only a small amount to global warming or acid rain.

Limitations
- The long-term radioactive waste storage problems of nuclear power have not been solved.
- New Nuclear power plants are extremely expensive and taken a long time to build.

Hydro generation

Benefits
- Hydroelectric power stations can promptly increase to full capacity, unlike other types of power stations. This is because water can be accumulated above the dam and released to coincide with peak demand.
- Electricity can be generated constantly, so long as sufficient water is available.
- Hydroelectric power produces no primary waste or pollution.

Limitations
- The construction of a dam and hydroelectric power station can have an environmental impact on the surrounding areas.
- Dams can contain huge amounts of water and as with every energy storage system, failure of containment can lead to catastrophic results.

Wind generation

Benefits
- Wind towers can be beneficial for people living permanently, or temporarily, in remote areas. It may be difficult to transport electricity from a power plant to a far-away location and thus, wind towers can be set up at the remote setting.
- Farming and grazing can still take place on land occupied by wind turbines. Those utilising wind power in a grid-tie configuration will have backup power in the event of a power outage.
- Because of the ability of wind turbines to coexist within agricultural fields siting costs are frequently low.

Limitations
- Wind is unpredictable; therefore, wind power is not predictably available.
- Wind farms may be challenged in communities that consider them an eyesore or obstruction. **4 x [2]**

Q.4 Name a product which has been subjected to incremental improvements over time and explain the reasons for two of these improvements. 2 x [4]

e.g. Electric Drill:

- Electronically controlled to reduce undue wear on the motors.
- They have manual selection of hammer action making them easier to drill into hard materials such as concrete.
- They also have auto lock keyless chucks. (Chuck keys easily lost.)
- Drills have forward and reverse indicator LEDs + Power light.
- Many have built-in LED. Power light means the work piece is always well lit and clearly visible.

Note: Responses may also make reference to historical changes due to new manufacturing techniques and/or the development of new materials.

Q.5 Give reasons why an understanding of the product life cycle is so important when deciding on strategies to sell a product. [8]

Reasons:
Knowledge of the life cycle will enable retailers to gauge when promotion is required by a product and also the type of promotion. It will provide knowledge of the anticipated product life so that the possibility of incremental improvements may boost sales. If the product is anticipated to have a very short life cycle then sales can be maximised by early intense promotion. A product which is anticipated to have a long product life will require many sales and promotion strategies during the life of the product.

SECTION B

*Answer **three** questions from this section*
*This section is designed to demonstrate your **breadth** of knowledge in Product Design.*

Each question carried 8 marks.

Q.6 Explain why the development and refinement of aesthetic values is so important to the designer. [8]

Note : To do with the appearance of a product and the emotional responses it evokes. Cultures may have different values.

- **Aesthetic design values** make up an important part of what influences designers when they make their design decisions. However, designers are not always influenced by the same values and intentions. Value and intentions. Value and intentions differ between different design movements. It also differs between different schools of design as well as among individuals and designers.
- Creation of a brand identity using the work of designers to exemplify answers.
- The differences in values and intentions are directly linked to the diversity in design outcomes that exist within design. It is also a big contributing factor as to how a designer operates in his/her relation to clients.
- Different design values tend to have a considerable history and can be found in numerous design movements. The influence that each design value has had on design movements and individual designers has varied throughout history.

Q.7 Describe the impact that innovation has on the success of products. [8]

Innovation is the application of better solutions that meet new requirements or existing market needs. This is achieved through more effective products, processes, services technologies, or ideas that are really available to markets, governments and society.

The term innovation can be defined as something original and, as consequence, new that "breaks in to" the market or into society. One usually associates to new phenomena that are important in some way. A definition of the term, in line with these aspects, would be the following: "An innovation is something original, new and important - in whatever field - that breaks in to (or obtains a foothold in) a market or society."

While something novel is often described as an innovation, in economics, management science and other fields or practice and analysis it is generally considered a process that brings together various novel ideas in a way that they have an impact on society. Better sales, examples of products that save lives that are innovative and create a better life style.

Innovation differs from invention in that innovation refers to the use of a better and, as a result, novel idea or method, whereas invention refers more directly to the creation of the idea or method itself.

Innovation differs from improvement in that innovation refers to the notion of doing something different rather than doing the same thing better which has a direct impact on the consumer making the product successful.

Q.8 (a) Name two composite materials. [2]

Name of two composite materials such as MDF, GRP, are suitable, etc.
Carbon or glass fibre are acceptable (also engineered wood, plywood and a range of specific manufactured boards).

(b) Describe what you understand by the term composite materials. [6]

Composite materials are materials made from two or more constituent materials with significantly different physical or chemical properties, that when combined, produce a material with characteristics different from the individual components.

The individual components remain separate and distinct within the finished structure.

The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.

Accept carbon, glass fibre and engineered wood.

Q.9 Describe the essential features of:

(a) Registered Design [4]

Note: to do with the external design, shape, configuration, pattern etc. Must be new and applied by industrial processes (lasts up to twenty five years).

A Registered Design is a legal right which protects the overall visual appearance of a product or a part or a part of a product in the country or countries you register it. For the purposes of registration, a design is legally defined as being "the appearance of the whole or part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture or materials of the product or ornamentation. "This means that protection is given to the way a product *looks.*

The appearance of your product may result from a combination of elements such as shapes, colours and materials.

Reference to texture and materials does not mean that protection may be granted for the feel of a texture, or what the product is actually made from; only that these features may influence what the overall product looks like. Equally, design registration cannot protect non-stylised working (i.e. basic text), the way something works, or the idea or concept behind a product.

You can register a three-dimensional product such as an industrial or handicraft item (other than a computer program) or two-dimensional ornamentation alone, e.g. a pattern intended for display upon a product, or a stylised logo. In all cases, the term "product" can mean things like packaging, get-up, graphic symbols, typographic typefaces, and parts of products intended to be assembled into a more complex product.

(b) Registered Trade Marks. [4]

- Any sign which can be represented graphically.
- Any sign which can distinguish goods or services.
- Includes words, personal names, designs, letters and the shape of goods and their packaging.
- Registered for 10 years and can be renewed every 10 years indefinitely.

Q.10 Evaluate the effect of market research in ensuring the success of products that enter the market place. [8]

Market research is any organised effort to gather information about target markets or customers. It is a very important component of business strategy. The term is commonly interchanged with **marketing research**; however, expert practitioners may wish to draw a distinction, in that *marketing* research is concerned specifically with markets.

Market research is a key factor to maintain competitiveness over competitors. Market research provides important information to identify and analyse the market need, market size and competition.

'Market research, which includes social and opinion research, is the systematic gathering and interpretation of information about individuals or organisations using statistical and analytical methods and techniques of the applied social sciences to gain insight or support decision making.'

SECTION C

Section C involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

Level 1 0-9 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 10-14 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral. These aspects are not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 15- 20 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has demonstrated a knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical /moral issues. These aspects are considered. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 21-26 marks	• The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues. These aspects are considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

*Answer **two** questions from the section.*

*Your answer should be substantial and show the **depth** of your knowledge in Product Design*

Q.11 Prior to use in the manufacture of products, raw materials are processed and finished to make them suitable for use.

Explain how a material you are familiar with, is processed and finished into a form which is suitable for use in the manufacture of products. [26]

Response may refer to any material area.

i.e. pulp to paper, ore to metal, natural fibre to fabric, etc.

Full description of how a particular material is processed and finished to a point where the material can be ready for distribution to manufacturing centres to be produced into products for consumers. An example would be materials such as red deal, copper, polycotton, aluminium, steel, etc.

Q.12 Evaluate the design features of products developed by a designer you are familiar with, suggesting why the products have become successful and how they have influenced the development of similar products. [26]

Candidates should select a designer and give a detailed description of that designer's style indicating features about the style that clearly identifiable to the designer. The question also asks the candidate to describe how this designer has influenced other similar products on the market.

Note: Look for reference to '*influencing similar products'* in the responses.

Q.13 "Design must reflect the practical and aesthetic ...but above all...good design must primarily serve people."

[Thomas J Watson]

Suggest ways in which this quote can be applied to good design. [26]

Philosophical discussion about the impact that the function and aesthetic value of products in terms of sales and why people buy products.
Function of the product does it work well? Is it necessary device or a supplementary enhancing to living.
Does it look pleasing to the customer and what are the requirements of certain products to be aesthetically pleasing.
How well does it serve its target audience?

Q.14 Describe a product that you consider to be a 'design classic', giving reasons for its classification, and trace the development of the product through time.

[26]

Definition:

- Has a timeless aesthetic value.
- A standard of its kind.
- Has historical significance.
- Enduring, elegance.

Example may include the Coca Bottle (see the example below),
London telephone Box, London Underground map, the miniskirt or Little Black Dress (LBD) etc.

Identification of the design classic such as the Coca Cola bottle which was first designed in 1915 to prevent the brand from being imitated by other bottlers. The Coca Cola bottle, called the "contour bottle" within the company, but known to some as the "hobble skirt" bottle, was created by bottle designer Earl R Dean. In 1915 the Coca Cola Company launched a competition among its bottle suppliers to create a new bottle for their beverage that would distinguish it from other beverage bottles, "a bottle which a person could recognise even if they felt it in the dark, and so shaped that, even if broken, a person could tell at a glance what it was."

Chapman J. Root, president of the Root Glass Company of Terre Haute, Indiana, turned the project over to members of his supervisory staff, including company auditor T. Clyde Edwards, plant superintendent Alexander Samuelsson, and Earl R. Dean, bottle designer and supervisor of the bottle molding room. Root and his subordinates decided to base the bottle's design on one of the soda's two ingredients, the coca leaf or the kola nut, but were unaware of what either ingredient looked like. Dean and Edwards went to the Emeline Fairbanks Memorial Library and were unable to find any information about coca or kola. Instead, Dean was inspired by a picture of the gourd-shaped cocoa pod in the Encyclopaedia Britannica. Dean made a rough sketch of the pod and returned to the plant to show Root. He explained to Root how he could transform the shape of the pod into a bottle. Root gave Dean his approval.

Faced with the upcoming scheduled maintenance of the mold-making machinery, over the next 24 hours Dean sketched out a concept drawing which was approved by Root the next morning. Dean then proceeded to create a bottle mold and produced a small number of bottles before the glass-molding machinery was turned off.

Chapman Root approved the prototype never made it to production since its middle diameter was larger than its base, making it unstable on conveyor belts. Dean resolved this issue by decreasing the bottle's middle diameter. During the 1916 bottle's convention, Dean's contour bottle was chosen over other entries and was on the market the same year. By 1920, the contour bottle became the standard for the Coca-Cola Company. Today, the contour Coca-Cola bottle is one of the most recognised packages on the planet..." even in the dark!".

One alternative depiction has Raymond Loewy as the inventor of the unique design, but, while Loewy did serve as a designer of Coke cans and bottles in later years, he was in the French Army the year the bottle was invented and did not emigrate to the United States until 1919. Others have attributed inspiration for the design not to the cocoa pod, but to a Victorian hooped dress.

In 1997, Coca-Cola introduced a "contour can," similar in shape to its famous bottle, on a few test markets, including Terre Haute, Indiana. The can has never been widely released

A new slim and tall can began to appear in Australia on December 20, 2006; it cost A$1.95. The cans have resemblance to energy drink cans. The cans were commissioned by Domino's Pizza and are available exclusively at their restaurants.

In January 2007, Coca-Cola Canada changed "Coca-Cola Classic" labelling, removing the "Classic" designation, leaving only "Coca-Cola stated this is merely a name change and the product remains the same.

In 2007, Coca-Cola introduced an aluminium can designed to look like the original glass Coca-Cola bottles.

In 2007, the company's logo on cans and bottles changed. The cans and bottles retained the red colour and familiar typeface, but the design was simplified, leaving only the logo and a plain white swirl (the "dynamic ribbon").

In 2008, in some parts of the world, the plastic bottles for all Coke varieties (including the larger 1.5-and 2-liter bottles) were changed to include a new plastic screw cap and a slightly taller contoured bottle shape, designed to evoke the old glass bottles.

Q.15 Evaluate the part that quality assurance and quality control have played in high volume product manufacturing. [26]

Look for a clear understanding or definition of both terms, i.e.

(a) Quality Assurance ensures quality in the process, therefore defects do not arise (a Managerial tool – defect prevention).
(b) Quality Control identifies defects in products before release (a Corrective tool – defect detection)

This must be a discussion about the impact of QC and QA on the process of high volume manufacturing.

Answers could include some historical references to the Chicago meat packers, or the production lines of Henry Ford in Detroit. The answers may also contain descriptions of both QA and QC but this information on its own would gain limited marks.

For improved marks the candidates must evaluate what impact QA and QC have had on high volume manufacturing.

GCE DESIGN & TECHNOLOGY - DT3 FOOD TECHNOLOGY

SUMMER 2015 MARK SCHEME

SECTION A

Q.1 Retailers sell products which are designed for consumers with food intolerances.

For a named food intolerance:

(a) Outline the symptoms [2]

Possible food intolerances could include wheat, gluten, lactose, dairy, yeast, etc.

Responses must focus on the *symptoms* of the intolerance. Do not award mark for naming a food intolerance.

Example

- Coeliac disease affects the small intestine.
- Common symptoms include diarrhoea, excessive wind, constipation, nausea and vomiting, stomach pain and discomfort in the digestive tract, anaemia, tiredness, headaches, weight loss and mouth ulcers.
- Can result in malnutrition and vitamin deficiencies owing to the reduced ability of the small intestine to properly absorb nutrients from good.
- May cause poor growth and failure to thrive in children.

(b) Describe how different food products have been adapted to meet the needs of consumers with this intolerance. [6]

Coeliac disease is an intolerance of gluten, a protein found in wheat, barley and rye so food products need to be made gluten free. Baked products can be made using gluten-free flours. For example, gluten-free bread is often made with ground flours from a variety of sources such as almonds, rice and sorghum. The lack of gluten makes it difficult for breads to retain their shape as they rise and to achieve a 'bread-like' texture. Xanthum gum, guar gum or corn starch may be added to compensate for the lack of gluten. Gravies, custards, soups and sauces are frequently thickened with wheat, rye, barley, or other gluten-containing flour. Some foods have small amounts of gluten added as stabilisers or thickeners, e.g. ice cream and ketchup. Alternatives to gluten can be used to carry out these functions, e.g. corn, potatoes, rice, tapioca, amaranth or arrowroot. Oats are not used in gluten-free food products because, although oats do not contain gluten, there is a substantive risk of cross-contamination from other cereals during growing/processing. Sometimes soya or nut flours are used in gluten-free food products to add protein and fibre.

Q.2 Explain what you understand by the term Computer-Integrated Manufacturing (CIM) as a system used in volume food production. [8]

Computer-Integrated Manufacturing (CIM) is the manufacturing approach of using computers to control the entire production process. This integration allows individual processes to exchange information with each other and initiate further actions. Through the integration of computers, manufacturing can be faster and less error-prone, although the main advantage is the ability to create automated manufacturing processes. CIM relies on closed-loop control processes, based on real-time input from sensors. Sensors provided feedback in various forms, e.g. temperatures, pH and weights, etc. It is also known as flexible design and manufacturing.

Q.3 Name a food product which has been subjected to incremental improvements over time and explain the reasons for two of these improvements. 2 x [4]

Candidates must focus their response on a named food product. Award up to four marks for each of two reasons for incremental improvements. Responses must focus on a food product, not the packaging.

Reasons might include:

- To maintain market interest / share.
- A food product where products have been varied and the range has been developed in order to extend range / increase sales / increase market share, etc. e.g. Mars chocolate and ice cream ranges.
- To improve nutritional / health properties, e.g. products which have been developed to, for instance, change the type of fat from saturated / hydrogenated or to reduce the salt content.
- To introduce the use of probiotics.
- In order to make a health claim, for example, to lower cholesterol through use of plant stanols / sterols. These products would include Benecol spreads / yoghurts.
- To remove allergens, e.g. gluten / lactose.
- As a result of technology push, e.g. encapsulation technology, Nestle's quest for the perfect food bubble.

Q.4 Give reasons why an understanding of the product life cycle is so important when deciding on strategies to sell a food product. [8]

Knowledge of the product life cycle will enable retailers to gauge when promotion of a product is required and also the type of promotion. It will give a knowledge of the anticipated product life so that the possibility of incremental improvements may boost sales. If the product is anticipated to have a very short life cycle then sales can be maximised by early intense promotion. A product which is anticipated to have a long product life may require many sales and promotion strategies during the life of the product. Some foods, e.g. Easter/Christmas foods have a short life cycle after which point sales will fall of completely so promotion will be relatively short and intense. There may have been initial discounting in order to encourage early purchases.

Q.5 (a) Outline briefly two factors affecting the growth of bacteria. 2 x [2]

Factors are:

- Temperature. Bacteria have a minimum, optimum and maximum temperature at which they will grow. The temperature for specific bacteria depends whether they are heat-loving or cold-loving. Psychrophiles grow in temperatures below 20^{q}C; thermophiles grow at higher temperatures (above 45^{q}C) and mesophiles in the range 5 to 63^{q}C (the danger zone).
- Oxygen. Some bacteria require oxygen to grow (aerobes or aerobic bacteria) e.g. Bacillus cereus. Others do not require oxygen (anaerobes or anaerobic bacteria) e.g. Clostridium.
- pH. Bacteria generally prefer a neutral pH of around 7. Most bacteria will not grow in pH of below 4.5.
- Moisture. Water activity controls microbial growth. Salt and sugar both lower water activity.
- Time; different bacteria will have different generation times. The time taken for bacteria to multiply will be affected by temperature.

(b) For any one of these factors, explain how the growth of bacteria is ` controlled within a named method of food preservation. [4]

Do not allow keeping foods chilled in the fridge. While this will reduce bacterial growth and increase shelf life, it would not be classed as a method of preservation.

SECTION B

Q.6 Evaluate the effect of market research in ensuring the success of food products that enter the market place. [8]

Market research is any organised effort to gather information about target markets or customers. It is a very important component of business strategy. It is a key factor to maintain competitiveness. Market research provides important information to identify and analyse the market size and competition.

Market research, which includes social and opinion research, is the systematic gathering and interpretation of information about individuals or organisations using statistical and analytical methods and techniques of the applied social sciences to gain insight or support decision making.

Effective market research enables products to meet the needs and wants of the target market so that products for which there is a real need/want are developed. It is used to help determine the selling price of a product by considering the price of competitor's products and price which the market will bear. Price may also be affected by elasticity of demand, again determined through effective market research.

Market research will also help determine the exact market place for a particular food product, in terms of region and market sector. May influence promotional strategies.

Q.7 (a) Outline the functions of protein in the diet. [2]

Proteins are the building blocks of life. Every cell in the human body contains protein. It is the major component of the skin, muscles, organs, glands, blood, etc. It is needed to repair cells and to make new ones. It is needed for growth and development in childhood, adolescence and pregnancy. Any excess is used to provide energy.

Award maximum of **one** mark for 'growth, repair (and energy).'

(b) Using examples of named foods, explain in detail the meaning of the term 'biological value' and discuss its importance in diet planning. [6]

Proteins are made up of amino-acids. Indispensable (previously known as essential) amino-acids cannot be made by the body. Dispensable (previously know as non-essential) amino-acids can be made by the body from excess amounts of other amino-acids. Individual vegetable proteins such as cereals, nuts, seeds, potatoes and pulses do not contain all of the indispensable amino-acids needed by humans, so are said to have a low biological value. Most animal proteins, such as meat, fish, eggs and dairy, contain all of the indispensable amino-acids needed by humans so are said to have a high biological value. Quorn contains all of the dispensable amino-acids. In order to obtain all of the essential amino-acids from a diet based on vegetable proteins it is essential to have a mixture of different vegetable proteins in order to obtain the different indispensable amino-acids from different foods.

Q.8 Explain how prototyping and trialling are used within the development of new food products. [8]

Prototyping and trialling are used:

- to test organoleptic qualities to provide information for further development;
- to test functional qualities to provide information for further development;
- to test manufacturing techniques;
- to generate food products for consumer testing in order to determine what elements of the food product are popular/unpopular with potential consumers;
- to help generate differentiation from competitors' products;
- to generate food products for trial launch in, e.g. few stores / one region;
- to help calculate costs;
- to obtain accurate information regarding weights, nutritional information for packaging;
- to check scaling up is correct, e.g. level of seasoning;
- to assist training of staff;
- to better consider Quality Control; ensuring product consistency can be obtained/maintained.

Q.9 Describe the essential features of:

(a) Registered Designs. [4]

A Registered Design is a legal right which protects the overall visual appearance of a product or a part of a product in the country or countries it is registered. For the purposes of registration, a design is legally defined as being 'the appearance of the whole or part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture or materials of the product or ornamentation.' This means that protection is given to the way a product *looks*. The appearance of the product may result from a combination of elements such as shapes, colours and materials.

References to texture and materials does not mean that protection may be granted for the feel of a texture, or what the product is actually made from; only these features may influence what the overall product looks like. Equally, design registration cannot protect non-stylised wording (i.e. basic text) the way something works, or the idea or concept behind a product.

The term 'product' can mean packaging graphic symbols and typographic typefaces.

(b) Registered Trade Marks. [4]

- Any sign which can be represented graphically.
- Any sign which can distinguish goods or services.
- Includes words, personal names, signs, letters and the shape of goods and their packaging.
- Registered for ten years and can be renewed every ten years indefinitely.

Q.10 (a) Describe the use of two named items of industrial equipment used within the large-scale manufacture of food products. 2 x [2]

(b) Describe the benefits of using these items of equipment to manufacture food products. [4]

Examples of industrial equipment might include rack/deck ovens, checkweigher, gyroblast chiller, rotary cutters, vertical spindle mixer, flow wrapper, breakrollers, travelling oven, etc.

Award up to four marks for describing use of the piece of equipment, possibly with examples. Candidates should evaluate the use of the equipment in terms of standardisation of product, quality of food products, scale of production, speed, ease of use, versatility, safety, etc.

Example:
Rotary cutters are used to cut out large quantities of, e.g. biscuits. Dough passes through rollers which cut out the shapes – different dyes used for different shapes. Various patterns can be imprinted into the dough to allow for more intricate designs. Ensures standardisation as every biscuit es exactly the same size and shape and human error has been eradicated. High rate of production.

Travelling oven. Foods to be baked pass through the travelling oven on a conveyor belt. The temperature of the oven and speed of the belt is computer controlled to ensure that each product is in the oven for exactly the correct amount of time to ensure perfect cooking. Very efficient in terms of standardisation as well as safe for staff as removes risk of burns from putting items in and out of ovens and, e.g. back injuries from lifting large, heavy trays of food in and out of rack ovens.

SECTION C

Section C involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

Level 1 0-9 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak, impacting on effective communication.
Level 2 10-14 marks	• The candidate has a basic understanding of the issues associated with the question. • The use of terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical/moral. These aspects are not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 15-20 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use of terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has demonstrated knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical/moral issues. These aspects are considered. • The candidate will express moderately complex ideas clearly and fluently, through well-linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 21-26 marks	• The candidate demonstrates a specific ability to analyse questions, takes into account a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • The candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical/moral issues. These aspects are considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

Q.11 Discuss in detail how named food materials can be manipulated and combined in order to enhance named food products. [26]

Discussion of the properties and characteristics of food materials and how these can be enhanced by particular combinations of foods / ways of manipulating them in food manufacture. manipulation might include forms of mixing, forming, shaping, extrusion, exposure to hear/cold, etc. Discussion of the effect of combining different foods within a recipe, emulsions, foams, sols, gels.

Q.12 Food related health issues are increasingly becoming a major concern.

Discuss the impact of poor diet on health and describe how food products have been adapted to address these issues. [26]

answers may include reference to current government nutritional guidelines, e.g. Food Standards Agency 'Eatwell' plate, etc. Candidates may discuss the impact of diets high in fat/sugar/salt, low in vitamins, minerals, fibre, etc. Responses should relate to the design and re-design of healthier food products, for example, reduction in fat, particularly saturated and hydrogenated fats, increased use of artificial sweeteners, reduction in salt, increased use of wholegrains and products such as 'white bread with all the goodness of brown'; food products being fortified with omega 3; probiotics, etc. Increased use of Quorn.

Q.13 Evaluate the importance of food packaging to the manufacturer, retailer and consumer and discuss to what extent packaging can enhance a food product. [26]

Discussion may focus on a range of factors, for example, safety/contamination issues; preservation / shelf-life, tamperproof packaging; marketing; image; corporate identity; sustainability; suitability for target market; ergonomics; cost; materials; information including nutritional data such as traffic light labelling; meeting legal requirements regarding labelling, technical advances, e.g. MAP, etc. Candidates may discuss negative aspects of food packaging, e.g. environmental impact, use of energy/resources, etc. as well as positive. Discussion will make reference to various functions of food packaging. To access the full range of marks, reference must be made to the manufacturer, retailer and consumer.

Q.14 Explain the purpose of design specifications and manufacturing specifications when developing and producing food products. [26]

Responses should discuss the use of quality design specifications for designing. developing and evaluating. The purpose of a design specification is to provide the designer/food technologist with details of what a not-yet-designed food product is intended to do. Its aim is to ensure that the subsequent design and development of a food product meets the needs and wants of the user. This includes aims of the food product, how it is to achieve its purpose, the target market, nutritional factors, costs, appearance and finish (aesthetic and organoleptic considerations) etc. It also allows the designer/food technologist to test and evaluate the resulting product against user needs and to make modifications/adaptions so that the design better meets these needs it sets goals, sets targets, sets out specific measurable criteria. The design specification may have primary criteria (those which it is essential to meet) and secondary criteria (those which it is desirable to meet).

The purpose of a manufacturing specification is to provide the food manufacturer with details of exactly how the product is to be made, e.g. dimensioning, portioning, material details; specific manufacturing details; moulding/shaping/forming details; aesthetic (colour, texture, pattern) and organoleptic details, etc. This allows for detailed production planning and scheduling. It facilitates quality assurance and quality control.

Q.15 Evaluate the part that Quality Assurance and Quality Control play in high volume food manufacturing. [26]

This must be a discussion about the impact of QC and QA on the process of high volume food manufacturing. Responses may contain descriptions of both QA and QC, but candidates must evaluate what impact QA and QC have had. Candidates may discuss a range of factors including standardisation, reputation, speed and volume of production, computerisation, staffing issues, human involvement in food production, maintenance of records, inspection, etc.

GCE DESIGN & TECHNOLOGY - DT3 SYSTEMS AND CONTROL TECHNOLOGY

SUMMER 2015 MARK SCHEME

SECTION A

Q.1 Explain the terms customer needs and customer wants when making decisions about the designs of products. 2 x [4]

- Customer needs are essential features of a product that have to be included if the product is to be purchased by the consumer e.g. the cyclone technology that differentiated the product from it's competitors.
- Customer wants are supplementary features which could be included as enhancement features e.g. aesthetic dealing in terms of the colour of motor cars.

Q.2 Designers often adopt a 'systems' type approach when developing control systems.

Explain, with diagrams, the type of 'systems' approach they may take and evaluate how this contributes to the development of an effective control system. [8]

The systems approach is an approach that entails analysis of problems and come up with a blend of solutions. It is a generally approach that involves tackling problems in an advanced disciplined manner keeping priorities in mind. It is a branch of systems thinking process. Block diagrams INPUT, PROCESS, OUTPUT often help systems designers to categorise aspects of the desired solution into manageable parts. This 'chunking' idea allows parts to be considered in isolation and then introduced back to the greater system as a whole. There may be a variety of graphical methods, including flowcharts, which help manage sequences of events, logical processing, and stages of a control system.

Q.3 Describe, giving reasons, one benefit and one limitation of using the following sources of energy when manufacturing products.

(a) Fossil fuels
(b) Nuclear fuels
(c) Hydro generation
(d) Wind generation **4 x [2]**

Note: Candidates may be given 1 mark for weak answers that refer to both benefits and limitations.

Fossil fuels

Benefits
- Fossil fuels are of great importance because they can be burned producing significant amounts of energy per unit weight.
- Natural gas, once flared -off as an un-needed by product of petroleum production, is now considered a very valuable resource.

Limitations
- Fossil fuels are non-renewable resources because they take millions of years to form.
- The production and use of fossil fuels raises huge environmental concerns.

Nuclear fuels

Benefits
- Stated estimates for fission fuel supply at known usage rates vary, from several decades to billions of years.
- The cost of making nuclear power, with current legislation, is about the same as making coal power, which is considered inexpensive.
- Nuclear power does not produce any primary air pollution or release carbon dioxide and sulphur dioxide into the atmosphere. Therefore, it contributes only a small amount to global warming or acid rain.

Limitations
- The long-term radioactive waste storage problems of nuclear power have not been solved.
- New Nuclear power plants are extremely expensive and taken a long time to build.

Hydro generation

Benefits
- Hydroelectric power stations can promptly increase to full capacity, unlike other types of power stations. This is because water can be accumulated above the dam and released to coincide with peak demand.
- Electricity can be generated constantly, so long as sufficient water is available.
- Hydroelectric power produces no primary waste or pollution.

Limitations
- The construction of a dam and hydroelectric power station can have an environmental impact on the surrounding areas.
- Dams can contain huge amounts of water and as with every energy storage system, failure of containment can lead to catastrophic results.

Wind generation

Benefits

- Wind towers can be beneficial for people living permanently, or temporarily, in remote areas. It may be difficult to transport electricity from a power plant to a far-away location and thus, wind towers can be set up at the remote setting.
- Farming and grazing can still take place on land occupied by wind turbines. Those utilising wind power in a grid-tie configuration will have backup power in the event of a power outage.
- Because of the ability of wind turbines to coexist within agricultural fields siting costs are frequently low.

Limitations

- Wind is unpredictable; therefore, wind power is not predictably available.
- Wind farms may be challenged in communities that consider them an eyesore or obstruction.

Q.4 When developing successful control systems for products, designers must consider market 'push and pull' forces. Using named products, explain how 'push and pull' forces have dictated control system development. [8]

Market pull will be where the consumers have demanded certain features, functions or performance criteria. Technology Push is where new technology, methods, materials etc. become available for exploiting by designers to drive products forward. Without the careful consideration of push pull forces, designers would be ignoring both the available methods at their disposal and the desired success criteria from potential consumers, thus the likeliness of a successful product is small. Many push forces promote USPs where new products can offer advanced functions and performance. Pull tends to encourage revitalised products development where slight changes are required to an existing line of products or range.

Q.5 Give reasons why an understanding of the product life cycle is so important when deciding on strategies to sell a product. [8]

Reasons:

Knowledge of the life cycle will enable retailers to gauge when promotion is required by a product and also the type of promotion. It will give provide knowledge of the anticipated product life so that the possibility of incremental improvements may boost sales. If the product is anticipated to have a very short life cycle then sales can be maximised by early intense promotion. A product which is anticipated to have a long product life will require many sales and promotion strategies during the life of the product.

SECTION B

Answer **three** *questions from this section.*

This section is designed to demonstrate your **breadth** *of knowledge in Systems and Control Technology.*

Each question carries 8 marks.

Q.6 Describe why the development and refinement of functional values is so important to the designer of control systems. [8]

- **Aesthetic design values** make up an important part of what influences designers when they make their design decisions. However, designers are not always influenced by the same values and intentions. Value and intentions. Value and intentions differ between different design movements. It also differs between different schools of design as well as among individuals and designers.
- The differences in values and intentions are directly linked to the diversity in design outcomes that exist within design. It is also a big contributing factor as to how a designer operates in his/her relation to clients.
- Different design values tend to have a considerable history and can be found in numerous design movements. The influence that each design value has had on design movements and individual designers has varied throughout history.
- The actions that the device or product is expected to undertake. Without function, a control system and product will not work. This will render the product unsuccessful. Form v Function deserves credit. Ergonomics for user interface, anthropometric data for positioning of buttons and controls, access to replace batteries, parts, servicing and maintenance access, fitness for purpose, built to last and withstand the intended working environments.)

Q.7 Describe the impact that innovation has on the success of products. [8]

Innovation is the application of better solutions that meet new requirements or existing market needs. This is achieved through more effective products, processes, services technologies, or ideas that are really available to markets, governments and society.

The term innovation can be defined as something original and, as consequence, new that "breaks in to" the market or into society. One usually associates to new phenomena that are important in some way. A definition of the term, in line with these aspects, would be the following: "An innovation is something original, new and important - in whatever field - that breaks in to (or obtains a foothold in) a market or society."

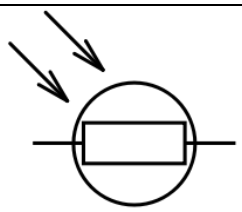
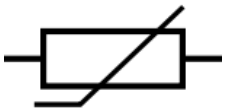
While something novel is often described as an innovation, in economics, management science and other fields or practice and analysis it is generally considered a process that brings together various novel ideas in a way that they have an impact on society. Better sales, examples of products that save lives that are innovative and create a better life style.

Innovation differs from invention in that innovation refers to the use of a better and, as a result, novel idea or method, whereas invention refers more directly to the creation of the idea or method itself.

Innovation differs from improvement in that innovation refers to the notion of doing something different rather than doing the same thing better which has a direct impact on the consumer making the product successful.

Q.8 (a) Name, and sketch the circuit symbols for, two different input components used in electronic control systems. [2]

(b) Describe how both input components react when used as inputs in control systems of your choice. [6]

	
LDR - Light Dependent Resistor / photo resistor	Thermistor
A **photo resistor** or **light dependent resistor** (**LDR**) or **photocell** is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance. A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap. Extrinsic devices have impurities, also called dopants, and added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.[2]	Thermistors can be classified into two types, depending on the sign of k. If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (**PTC**) thermistor, or **posistor**. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (**NTC**) thermistor. Resistors that are not thermistors are designed to have a k as close to zero as possible, so that their resistance remains nearly constant over a wide temperature range. Many NTC thermistors are made from a pressed disc or cast chip of a semiconductor such as a sintered metal oxide. They work because raising the temperature of a semiconductor increases the number of electrons able to move about and carry charge - it promotes them into the *conduction band*. The more charge carriers that are available, the more current a material can conduct. Most PTC thermistors are of the "switching" type, which means that their resistance rises suddenly at a certain critical temperature. The devices are made of a doped polycrystalline ceramic containing barium titanate ($BaTiO_3$) and other compounds. The dielectric constant of this ferroelectric material varies with temperature. Below the Curie point temperature, the high dielectric constant prevents the formation of potential barriers between the crystal grains, leading to a low resistance. In this region the device has a small negative temperature coefficient. At the Curie point temperature, the dielectric constant drops sufficiently to allow the formation of potential barriers at the grain boundaries, and the resistance increases sharply. At even higher temperatures, the material reverts to NTC behaviour

Q.9 Describe the essential features of:

(a) Registered design; [4]

(b) Registered Trademarks. [4]

(a) Registered design [4]

Note: to do with the external design, shape, configuration, pattern etc.
Must be new and applied by industrial processes (lasts up to twenty five years).

A Registered Design is a legal right which protects the overall visual appearance of a product or a part or a part of a product in the country or countries you register it. For the purposes of registration, a design is legally defined as being "the appearance of the whole or part of a product resulting from the features of, in particular, the lines, contours, colours, shape, texture or materials of the product or ornamentation. "This means that protection is given to the way a product *looks.*

The appearance of your product may result from a combination of elements such as shapes, colours and materials.

Reference to texture and materials does not mean that protection may be granted for the feel of a texture, or what the product is actually made from; only that these features may influence what the overall product looks like. Equally, design registration cannot protect non-stylised working (i.e. basic text), the way something works, or the idea or concept behind a product.

You can register a three-dimensional product such as an industrial or handicraft item (other than a computer program) or two-dimensional ornamentation alone, e.g. a pattern intended for display upon a product, or a stylised logo. In all cases, the term "product" can mean things like packaging, get-up, graphic symbols, typographic typefaces, and parts of products intended to be assembled into a more complex product.

(b) Registered Trade Marks. [4]

- Any sign which can be represented graphically.
- Any sign which can distinguish goods or services.
- Includes words, personal names, designs, letters and the shape of goods and their packaging.
- Registered for 10 years and can be renewed every 10 years indefinitely.

Q.10 Using named products, evaluate how far the control system is responsible for products'

(a) Incrementally developed and

(b) radical new development. [8]

Popular responses may feature the iPod or iPhone, iPad or MacBook.. As such improved touch screen technology provides an advanced interface between product and consumer. Improved control systems such as processor speed and memory has allowed newer generation products to become faster at performing the multiple tasks, and also store more data, songs, videos etc. on iPod. The iPhone 4 to 4S saw voice recognition introduced, 4s to 5 the introduction of the retina display improving screen quality. Candidates must display an in-depth knowledge of products and control systems beyond 'lay' terms. Reference must be made to 'facelifts' that improve existing designs, and new technology that allows transformation of radically different products to supersede older versions.

SECTION C

Section C involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

Level 1 0-9 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 10-14 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral. These aspects are not always considered. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 15- 20 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • The candidate has demonstrated a knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical /moral issues. These aspects are considered. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 21-26 marks	• The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues. These aspects are considered where appropriate. • The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

Answer **two** *questions from this section.*

Your answer should be substantial and show the **depth** *of your knowledge in Systems and Control Technology.*

Each question carries 26 marks.

Q.11 During your studies, selecting appropriate materials and components has been critical when developing effective control systems for products.

Using named materials and / or components, describe how their specific properties and characteristics have made them suitable for use in control systems for products. [26]

A detailed understanding of the materials and /or components together with their Properties and characteristics. The intended use must be clearly described and reasoning for the selection of the relevant materials and components over other suitable alternatives. Candidates must include the rigorous testing, modelling and trialling that were undertaken during development to see whether the relevant materials and components would be appropriate. Reference to testing data and results is critical here.

Q.12 Describe the design cycle of a designer you are familiar with, indicating how their design style has influenced the development of similar products on the market [26]

Candidates should select a designer and give a detailed description of that designer's style indicating features about the style that clearly identifiable to the designer. The question also asks the candidate to describe how this designer has influenced other similar products on the market. If the latter is not included in the answer maximum marks awarded within level 2.

Q.13 ”Design is not just what it looks like and feels like, Design is how it works.”

Steve Jobs

Using this statement, evaluate the contribution of the control system to creating an innovative product. [26]

A full and detailed discussion of how form and function factors morph to create innovative products. Candidates should explore the importance of function, and how it is critical for designers to establish a clear understanding for what the device is intended. Examples such as juicy salif may serve as typical products that are iconic yet the function is sadly lacking, where form was considered superior to function. Similarly, pre-Apple computers described as ‘boring beige boxes’ served function with the absence of any design consideration towards looks, aesthetics, styling and tactile finishing. A balanced response would generally conclude that whilst all three factors in this quote are important, without the functional element the fundamental requirement for the product is in question.

Q.14 Describe a product that you consider to be a 'design classic', giving reasons for its classification, and trace the development of the product through time.

[26]

Definition:

- Has a timeless aesthetic value.
- A standard of its kind.
- Has historical significance.
- Enduring, elegance.

Example may include the Coca Bottle (see the example below),
London telephone Box, London Underground map, the miniskirt or Little Black Dress (LBD) etc.

Identification of the design classic such as the Coca Cola bottle which was first designed in 1915 to prevent the brand from being imitated by other bottlers. The Coca Cola bottle, called the "contour bottle" within the company, but known to some as the "hobble skirt" bottle, was created by bottle designer Earl R Dean. In 1915 the Coca Cola Company launched a competition among its bottle suppliers to create a new bottle for their beverage that would distinguish it from other beverage bottles, "a bottle which a person could recognise even if they felt it in the dark, and so shaped that, even if broken, a person could tell at a glance what it was."

Chapman J. Root, president of the Root Glass Company of Terre Haute, Indiana, turned the project over to members of his supervisory staff, including company auditor T. Clyde Edwards, plant superintendent Alexander Samuelsson, and Earl R. Dean, bottle designer and supervisor of the bottle molding room. Root and his subordinates decided to base the bottle's design on one of the soda's two ingredients, the coca leaf or the kola nut, but were unaware of what either ingredient looked like. Dean and Edwards went to the Emeline Fairbanks Memorial Library and were unable to find any information about coca or kola. Instead, Dean was inspired by a picture of the gourd-shaped cocoa pod in the Encyclopaedia Britannica. Dean made a rough sketch of the pod and returned to the plant to show Root. He explained to Root how he could transform the shape of the pod into a bottle. Root gave Dean his approval.

Faced with the upcoming scheduled maintenance of the mold-making machinery, over the next 24 hours Dean sketched out a concept drawing which was approved by Root the next morning. Dean then proceeded to create a bottle mold and produced a small number of bottles before the glass-molding machinery was turned off.

Chapman Root approved the prototype never made it to production since its middle diameter was larger than its base, making it unstable on conveyor belts. Dean resolved this issue by decreasing the bottle's middle diameter. During the 1916 bottle's convention, Dean's contour bottle was chosen over other entries and was on the market the same year. By 1920, the contour bottle became the standard for the Coca-Cola Company. Today, the contour Coca-Cola bottle is one of the most recognised packages on the planet..." even in the dark!".

One alternative depiction has Raymond Loewy as the inventor of the unique design, but, while Loewy did serve as a designer of Coke cans and bottles in later years, he was in the French Army the year the bottle was invented and did not emigrate to the United States until 1919. Others have attributed inspiration for the design not to the cocoa pod, but to a Victorian hooped dress.

In 1997, Coca-Cola introduced a "contour can," similar in shape to its famous bottle, on a few test markets, including Terre Haute, Indiana. The can has never been widely released.

A new slim and tall can began to appear in Australia on December 20, 2006; it cost A$1.95. The cans have resemblance to energy drink cans. The cans were commissioned by Domino's Pizza and are available exclusively at their restaurants.

In January 2007, Coca-Cola Canada changed "Coca-Cola Classic" labelling, removing the "Classic" designation, leaving only "Coca-Cola stated this is merely a name change and the product remains the same.

In 2007, Coca-Cola introduced an aluminium can designed to look like the original glass Coca-Cola bottles.

In 2007, the company's logo on cans and bottles changed. The cans and bottles retained the red colour and familiar typeface, but the design was simplified, leaving only the logo and a plain white swirl (the "dynamic ribbon").

In 2008, in some parts of the world, the plastic bottles for all Coke varieties (including the larger 1.5-and 2-liter bottles) were changed to include a new plastic screw cap and a slightly taller contoured bottle shape, designed to evoke the old glass bottles.

Q.15 Evaluate the part that Quality Assurance and Quality Control have played in high volume product manufacturing. [26]

Look for a clear understanding or definition of both terms i.e.

(a) Quality Assurance ensures quality in the process, therefore defects do not arise (a Managerial tool – defect prevention).
(b) Quality Control identifies defects in products before release (a Corrective tool – defect detection)

This must be a discussion about the impact of QC and QA on the process of high volume manufacturing.

Answers could include some historical references to the Chicago meat packers, or the production lines of Henry Ford in Detroit. The answers may also contain descriptions of both QA and QC but this information, on its own, would gain limited marks.

For improved marks the candidates must evaluate what impact QA and QC have had on high volume manufacturing.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk