

**Product Design
(Higher)**

First edition – published 2004

National Course Specification

PRODUCT DESIGN (Higher)

COURSE CODE C211 12

COURSE STRUCTURE

This Course has three mandatory Units:

<i>DF4V 12</i>	<i>Product Design: Design Analysis</i>	<i>1 credit (40 hours)</i>
<i>DF4W 12</i>	<i>Product Design: Developing Design Proposals</i>	<i>1 credit (40 hours)</i>
<i>DF4X 12</i>	<i>Product Design: Manufacturing Products</i>	<i>1 credit (40 hours)</i>

All Courses include 40 hours over and above the 120 hours for the component Units. This may be used for induction, extending the range of learning and teaching approaches, support, consolidation, integration of learning and preparation for external assessment.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained one of the following or equivalent:

- ◆ Standard Grade Craft and Design at Credit level
- ◆ Standard Grade Graphic Communication at Credit level
- ◆ Standard Grade Art and Design at Credit level
- ◆ Intermediate 2 Product Design, or its Component Units

PROGRESSION

This Course or its component Units may provide progression to:

- ◆ Advanced Higher Product Design
- ◆ Higher National programmes in design, manufacturing or related subjects
- ◆ Higher Education programmes in design, manufacturing or related subjects
- ◆ training or employment

Administrative Information

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National Course Specification: (cont)

PRODUCT DESIGN (Higher)

CORE SKILLS

This Course gives automatic certification of the following:

Core Skills components for the Course Critical Thinking at Higher

CREDIT VALUE

The Higher Course in Product Design is allocated 24 SCQF credit points at SCQF level 6.

SCQF points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

National Course Specification: Course details

PRODUCT DESIGN (Higher)

RATIONALE

‘Manufacturing industry remains the cornerstone of the Scottish economy. Any decline poses a threat to the health, sustainability and diversity of the country and therefore to its infrastructure and the prosperity of its citizens... because of its diverse, dynamic nature, manufacturing needs people with equally diverse and adaptable skills.’ *Make it in Scotland* (www.makeitinscotland.co.uk)

This Course will help develop creative, flexible learners who are able to work autonomously, to achieve good quality, feasible proposals or outcomes through active experiences of product design. At its heart is creativity. The Course develops the ability to apply skills and knowledge in different situations — attributes which are becoming more and more valuable to individuals and organisations.

The Course offers candidates opportunities to explore the impact of design and technological activities in everyday life. Candidates will consider the complete life of a product, from its initial conception, through manufacture and marketing, to its impact on society.

This Course uses a wide range of teaching and learning approaches. Candidates are encouraged to adopt a broad view of the process of design and manufacture, take responsibility for their own actions and decisions, devise plans and procedures, develop and organise ideas and solve problems, make effective use of new and existing knowledge and justify their design decisions.

The Course will also provide candidates with the opportunity to solve practical problems in applied contexts.

Candidates undertaking this Course will be in a strong position to pursue further study in all areas of design and manufacturing. The Course will also contribute to personal development, augmenting transferable skills which will be useful regardless of the career path followed.

AIMS

The aims of the Course are to develop:

- ◆ the ability to produce solutions to design tasks by applying knowledge, understanding and problem solving skills
- ◆ knowledge and understanding of the process and principles of designing
- ◆ the ability to analyse and clarify problems in a design context
- ◆ an understanding of the issues which influence the design of products
- ◆ the application of effective graphic and modelling techniques
- ◆ knowledge and understanding of industrial manufacturing processes and materials
- ◆ the ability to effectively communicate and justify solutions to design tasks
- ◆ an understanding of economic considerations, and the social and environmental implications of design and manufacture
- ◆ and prepare candidates for further study of product design and manufacture.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

COURSE CONTENT

The Course consists of three mandatory Units, each of 40 hours.

The Course has been designed to allow the Units to be delivered sequentially, leading the candidate through the design process from problem identification to product manufacture. However, it should be noted that the Units can be delivered as stand-alone Units and in any order.

The Course content can be broken down into three main sections: designing, communicating and manufacturing. The following lists detail the Course content. Centres must ensure that the content is covered over the duration of the Course. All areas of the Course content will be open for sampling in the Course assessment.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

COURSE CONTENT (cont)

Designing

Candidates should have knowledge and understanding of the design process as applied to commercial products. They should be able to apply this knowledge and understanding to produce potential solutions to complex design tasks. In arriving at potential solutions they should be able to analyse, synthesise and evaluate alternative solutions.

Candidates should also have knowledge and understanding of the issues which affect the design and manufacture of commercial products. They should understand the relationships between these issues and the need for compromise when designing commercial products.

Members of a design team:	Designers, market researchers, accountants, engineers, manufacturers. Relationships between team members. Types of teams.
Problem identification:	Situation analysis, product evaluation.
Brief:	Purpose, statement of problem, target market.
Research:	Sources of recorded and non-recorded information, methods of gathering information. Analysis, application and presentation of researched material.
Specification:	Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification.
Idea generation:	Morphological analysis, thought showers, technology transfer, analogy, lateral thinking. Application of idea generation techniques.
Development and refinement of ideas:	Application of knowledge and understanding. Synthesis of ideas. Justification and recording of decisions taken. Presentation techniques. Modelling techniques.
Evaluation:	Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, comparison to specification. Application of evaluation techniques, presentation of results.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

Designing (cont'd)

Function:	Primary and secondary functions, fitness for purpose.
Performance:	Planned obsolescence, value for money, ease of maintenance, environmental concerns. Materials and manufacturing processes.
Market:	Consumer demands, social expectations, niche marketing, branding, introduction of new products.
Aesthetics:	Factors influencing aesthetics, influences of fashion, market trends, style.
Ergonomics:	Anthropometrics, psychology, physiology.
Economics:	Costs (fixed and variable), safety (British Standards, kite marks), market opportunity, intellectual property rights (confidentiality, patents, copyrights, design rights, trademarks, registered designs), value for money, production systems.

Communicating

Candidates should be able to produce quality graphics and apply a range of graphic techniques.

Candidates should be able to produce a range of quality models by applying practical skills and using a range of techniques and materials.

Graphic techniques:	Annotated sketches, working drawings, isometric, oblique, one point and two point perspective, exploded views, dimensioned views, illustration techniques, computer aided graphics, use of scale. The role of graphics in the design process. Use of graphic techniques to develop and communicate ideas. Orthographic drawing (elevation, end elevation, plan, outline, hidden detail, centre-line, dimensioning, section, hatch lines – all to BS conventions).
Range of modelling techniques and materials:	Scale models, mock-ups, fully crafted prototypes, test models, computer generated models, part product models, simulations, rapid prototyping. Use of appropriate modelling materials such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, plasticine, balsa wood, expanded foam, sheet plastic, construction kits. The role of modelling in the design process. Application of modelling techniques to develop and communicate ideas.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

Manufacturing

Candidates should be able to demonstrate knowledge of materials used in the commercial manufacture of products. They should be able to demonstrate knowledge of the characteristics of materials which make them suitable for producing particular products. They should be able to identify materials used in existing products and apply their knowledge of materials to the design of new products. It should be noted that candidates may refer to materials outside of the list given providing the material has appropriate characteristics for the intended use.

Candidates should be able to demonstrate knowledge of the principles of processes used in the commercial manufacture of products. They should be able to demonstrate knowledge of suitable processes for producing particular products. They should be able to identify processes used in existing products and apply their knowledge of processes to the design of new products.

Plastics:	Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers.
Metals:	Mild steel, high carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, duralumin, aluminium, copper, tin, lead, zinc.
Woods:	Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, parana pine, spruce.
Timber derivatives:	Manufactured boards (medium density fibreboard, plywood, blockboard, chipboard, hardboard), veneer.
Identification of materials:	Colour, surface texture, weight, properties, labelling and symbols.
Plastic processes:	Injection-moulding, extrusion, rotational moulding, vacuum-forming, blow-moulding, laminating, joining, compression moulding, finishing.
Metal processes:	Turning, milling, die-casting, pressing, stamping, punching, joining (spot welding, arc welding, riveting, adhesives, fitted joints, bolts, screws, patent devices), sand casting, casting, piercing and blanking, forging, finishing.
Wood processes:	Turning, routing, spindle moulding, laminating, jointing, finishing.
Identification of processes:	Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material at corners, shear marks, cross-section over length, surface texture.
Production systems:	One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

ASSESSMENT

To gain the award of the Higher Product Design Course, the candidate must pass all of the component Units and undertake the external assessment. The Course assessment provides the basis for grading attainment in the Course award.

DETAILS OF UNIT ASSESSMENT

All Units are internally assessed against the requirements of the Outcomes as detailed in the Unit Specifications. Unit Specifications also provide support notes to assist teachers and lecturers in their understanding of Outcomes, Performance Criteria and evidence requirements. Higher Product Design Unit assessments consist of design activity work, and the testing of knowledge, understanding and manual drawing skills.

In particular, the design activities of Units 1 and 2 assess a candidate's ability to apply knowledge and understanding to analyse and solve design problems. It should be noted however that there is no direct testing of knowledge and understanding in Units 1 and 2, but rather the design activities are intended to develop the knowledge and understanding that underpin these Units. Unit 2 also requires candidates to demonstrate their graphic and modelling skills.

Unit 3 tests candidates in two areas; their knowledge and understanding of commercial manufacturing materials and processes, and their ability to produce an orthographic drawing suitable for use in the manufacture of a given product.

DETAILS OF COURSE ASSESSMENT

The Higher Product Design Course is externally assessed against the Grade Descriptions as detailed in the Course Arrangements. The Course assessment will provide the basis for grading attainment in the Higher Product Design Course awards. Course awards will be graded A to D, and will be based on the total score achieved in the Course assessment.

The Course assessment of the Higher Product Design Course will consist of two equally-weighted components:

- ◆ Question Paper 70 marks
- ◆ Design Assignment 70 marks

Question Paper

The purpose of the Question Paper is to assess the candidate's ability to retain and integrate knowledge and understanding from across the Course content. It will also allow the candidate to demonstrate higher order cognitive and communication skills across the content of all the component Units of the Course in varied and less familiar contexts.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

The Question Paper will be of 2 hours duration, set and externally marked by the SQA. The paper will be composed of two sections:

◆ **Section A (30 marks)**

This section will consist of a single question requiring extended and reasoned responses. The question will follow a similar structure every year and will test the candidate's knowledge and understanding of areas from across the Course content. The question will also require candidates to integrate knowledge and understanding from across the Course content.

◆ **Section B (40 marks)**

This section will consist of 4 to 7 questions. The questions will sample content from across the Course and may require a degree of integration of knowledge and understanding. Candidates will be expected to answer all questions.

Further details of the format and structure of the Question Paper are given in the Course Assessment Specification.

Design Assignment

There are 70 marks available for the Design Assignment. The purpose of the Design Assignment is to assess the candidate's ability to apply skills, knowledge and understanding to solve a design task in a given context. In particular, it will test the candidate's ability to communicate, generate and refine ideas and produce a potential solution.

The Design Assignment task will be set by SQA, conducted internally and externally marked by SQA. SQA will issue details of the Design Assignment task in January and will require submission of the completed assignments by a specified date in the year of presentation. A different Design Assignment task will be issued each year by SQA.

Further details about the format and structure of the Design Assignment are given in the Course Assessment Specification and Design Assignment Guidance document.

RELATIONSHIP BETWEEN UNIT AND COURSE ASSESSMENTS

Unit and Course assessments are designed to compliment each other, but it has to be noted that there is a clear distinction between them in terms of their purpose, focus and requirements. This is achieved by careful targeting of knowledge, understanding and skills at appropriate levels in Unit and Course assessments and thereby avoiding any duplication of tasks, activities or performances.

The design activity work of Units 1 and 2 assessments prepare candidates for the more demanding problem solving task of the Design Assignment. Similarly, the knowledge and understanding test of Unit 3 helps candidates prepare for the wider scope and depth of the Question Paper. The knowledge and understanding that underpins the design activities of Units 1 and 2 is not tested at Unit level but is assessed in the Question Paper. Centres may therefore wish to test knowledge and understanding in Units 1 and 2 for diagnostic purposes and to prepare candidates for the Question Paper.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

The drawing test of Unit 3 cannot be taken forward and used as evidence for the Design Assignment. However, the orthographic drawing skills gained in Unit 3 may be taken forward and used in the Design Assignment.

THE ‘ADDED VALUE’ OF THE COURSE

Units are valuable freestanding bodies of learning and teaching in their own right, but candidates will gain considerable additional benefit from completing the whole Course as there are opportunities to integrate knowledge, understanding and extend the skills acquired throughout the Units.

Overall, the ‘added value’ of the Course is in the Course assessment providing opportunities for the candidate to demonstrate:

- ◆ retention of a range of knowledge, understanding and skills acquired from across the component Units
- ◆ integration of a range of knowledge, understanding and skills acquired from across the component Units
- ◆ application of a range of knowledge, understanding and skills in more complex contexts
- ◆ application of a range of knowledge, understanding and skills in less familiar contexts.

Another ‘added value’ aspect of the Course is that when Units are studied as part of the Course, opportunities exist for candidates to experience a range of integrated problems. Such problems require solutions that extend beyond the boundaries of the discrete Units of the Course. In particular, the Design Assignment will require candidates to solve problems of a more complex nature than required for a pass in the individual Units.

GRADE DESCRIPTIONS AT ‘A’ AND ‘C’

The candidate’s grade will be based on the total score obtained from the two components of the Course assessment, ie the Question Paper and the Design Assignment. The descriptions below indicate the nature of achievement required for the award of grades C and A in the Course.

For an award at Grade C, candidates should be able to:

- ◆ demonstrate knowledge and understanding of designing in a commercial context
- ◆ use design skills to generate a range of ideas and produce potential solutions
- ◆ apply knowledge and understanding to develop ideas
- ◆ identify issues which have influenced the design of products
- ◆ explain why particular processes and materials are used to manufacture commercial products
- ◆ communicate using a range of graphic and modelling techniques.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

For an award at Grade A, candidates should be able to:

- ◆ demonstrate detailed knowledge and clear understanding of designing in a commercial context
- ◆ use a broad range of design skills to generate a wide range of imaginative ideas and produce reasoned potential solutions
- ◆ apply a wide range of knowledge and understanding to develop and refine ideas
- ◆ identify a wide range of issues and explain how they have influenced the design of products
- ◆ appraise why particular processes and materials are used to manufacture commercial products
- ◆ communicate using a wide range of high quality graphic and modelling techniques.

ESTIMATES AND APPEALS

Estimates

As part of the examination cycle, centres are required to submit estimate grades of candidate performance in the Course assessment. In particular, estimates are used as the basis for Appeals and in the consideration of awards to absentee candidates. Estimates must therefore be based on sound and demonstrable evidence. Evidence used to compile estimates and support Appeals must be valid, reliable, and:

- ◆ be based on national standards and take account of the Course Grade Descriptions
- ◆ reflect the scope, nature and equal weighting of the components of the Course assessment (ie the Question Paper and the Design Assignment).

Further advice on the preparation of estimates is given in the Product Design Higher Course Assessment Specification document.

Appeals

The principal source of evidence used to support a Higher Product Design Appeal is an integrated test (eg a prelim) in respect of the Question Paper component.

The Design Assignment component is conducted internally over a period of time and thereby allows candidates the opportunity to develop, reflect upon and revise their work. Consequently, this will probably be the candidate's 'best work'. **It is therefore unlikely that Appeals evidence will be submitted for this component.** Only where evidence has been produced in response to a task equal to the scope, nature and demand of the Design Assignment, should evidence be submitted for this component.

Evidence submitted in respect of the Question Paper component must come from an integrated test that adequately reflects the Course content and Grade Descriptions. An integrated test or prelim should replicate the style, level of demand, mark allocation and weighting of the Specimen Question Paper. Reference should also be made to the Higher Product Design Course Assessment Specification document.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

Centres who submit an integrated test or prelim that only covers the knowledge and understanding of Units 1 and 2 should also submit an additional test covering the knowledge and understanding of Unit 3. Furthermore, this additional test must integrate the knowledge and understanding from Unit 1 and Unit 2.

While it is acceptable for centres generating their own test materials to draw on past SQA Question Papers, such papers **must not** be used in their entirety. Where material from past papers is used, a judicious selection of items and/or appropriate adaptation is required to make this acceptable as evidence to support an Appeal. Items from past SQA papers may also be supplemented or replaced by internally devised materials.

Whatever approach is taken to create an integrated test, prelim or other such assessment item, centres must be certain that the paper is not in the public domain and has not been seen previously by the candidates. It is the responsibility of centres to ensure the validity, reliability and security of assessment instruments used for Estimates and Appeals.

QUALITY ASSURANCE

The Units of the Course should be subject to internal moderation by centres and may also be selected for external moderation by SQA. The purpose of external moderation is to confirm that centres have carried out internal assessments in line with the national standard and in accordance with the relevant published Unit Specifications and Course Arrangements.

The Question Paper and the Design Assignment are subject to external marking by trained SQA markers. Markers meetings are held to ensure that a consistent standard is agreed and further quality assurance checks on the standard of marking are carried out to ensure that standards have been applied. The work of all markers is subject to scrutiny by the Principal Assessor and a Principal Assessor Report is published for the subject.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

APPROACHES TO LEARNING AND TEACHING

There is no ‘best way’ to approach the learning and teaching for this Course. The Course has been designed so that it is flexible enough to allow centres to deliver it in a way which suits the needs, abilities and aspirations of their candidates and the interest and expertise of their staff.

Strategies for delivery of Units

The Units have been designed so that they can be taught sequentially. However, they can be taught in any order, as stand-alone Units or concurrently. This allows for different approaches in the method of delivery of the Units:

- ◆ One design task could be carried across all three Units. This would mean that the specification drawn up in *Design Analysis* would be used as a starting point for *Developing Design Proposals*. Manufacturing processes and materials in *Manufacturing Products* would be taught in the context of the solution developed in *Developing Design Proposals*.
- ◆ An alternative approach would be to use a series of smaller design tasks which would focus on particular aspects of the Course.

Whichever approach is taken, centres must ensure that all the Outcomes are covered and the full Course content is delivered.

Contexts for learning and teaching

Designing is a practical activity and it is important that candidates are exposed to learning experiences which blend the acquisition of knowledge and understanding, the development of design skills and the opportunity to apply these to solve design tasks.

Practical activities may range from producing concept sketches on paper, quick modelling of ideas through to production of full-scale prototypes using more traditional craft skills. Centres are encouraged to deliver the Course using the practical activity contexts which appeal to candidate interests.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

Undertaking the Design Assignment

A Design Assignment task will be issued by the SQA in January for return by a specified date. The details of the assessment criteria are contained in the Design Assignment Guidance document. The decision of when to undertake the Design Assignment task rests with the centre. However, two issues should be considered when deciding the starting date.

- ◆ The Design Assignment is an assessment activity. It assesses the candidate's ability to apply skills, knowledge and understanding to solve a design task in a given context. The Design Assignment should, therefore, only be issued after sufficient teaching and learning has taken place. The Design Assignment should not be used as a teaching instrument.
- ◆ Candidates must be allowed sufficient time to complete the Design Assignment. However, candidates should not work continuously on the Design Assignment from January through to April. This would have a serious impact on the time available for learning, teaching and preparation for the Question Paper.

RELATIONSHIP BETWEEN HIGHER AND INTERMEDIATE 2

Product Design Courses have been designed in a hierarchical structure, and as such, it will be possible to deliver Higher and Intermediate 2 Courses together.

The Unit Specifications at Higher and Intermediate 2 contain common Outcomes and, therefore, it is important to distinguish between the levels. At Higher there is:

- ◆ a greater breadth and depth of content reflected in the Performance Criteria
- ◆ a greater emphasis on the integration of topics
- ◆ an increased emphasis on designing in more complex contexts.

SPECIAL NEEDS

This Course Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

PRODUCT DESIGN IN A BROADER CONTEXT

A number of national initiatives and programmes have been designed to promote themes that are important to contemporary society, such as citizenship and enterprise. These themes contribute to individual subjects and Courses by making connections beyond the subject boundaries and therefore enrich the learning experience. Similarly, the specialist knowledge and skills developed through the study of a particular subject contributes to the understanding of these themes.

National Course Specification: Course details (cont)

PRODUCT DESIGN (Higher)

Product Design offers many opportunities for the development of cross-curricular themes. Some of these are outlined as follows:

Enterprise in Education	Designing products for a target market. Developing skills to create new and innovative products. Developing an appreciation of how products are marketed.
Education for Citizenship	Working as part of a team. Developing an awareness of the social, cultural and environmental factors which influence the design of products.
Financial Education for all	Developing an awareness of the economic factors which influence the design of products.
Health Education	Designing products which are ergonomically sound and meet appropriate safety standards.

National Unit Specification: general information

UNIT	Product Design: Design Analysis (Higher)
NUMBER	DF4V 12
COURSE	Product Design (Higher)

SUMMARY

This Unit will enable candidates to evaluate commercial products and draw up specifications. Candidates will evaluate a commercial product. Candidates will also consider design issues when analysing a brief and drawing up a specification. The Unit is suitable for candidates with previous experience in related subjects (such as Craft and Design, Graphic Communication or Art and Design). It is also suitable as an introduction for candidates studying product design for the first time.

OUTCOMES

1. Evaluate a commercial product.
2. Establish a design specification from a brief.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have achieved one of the following:

- ◆ Standard Grade Craft and Design at Credit level
- ◆ Standard Grade Graphic Communication at Credit level
- ◆ Standard Grade Art and Design at Credit level
- ◆ The Unit *Product Design: Design Analysis* at Intermediate 2

Administrative Information

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National Unit Specification: general information (cont)

UNIT Product Design: Design Analysis (Higher)

CREDIT VALUE

1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

This Unit gives automatic certification of the following:

Core Skills components for the Unit

Critical Thinking at Higher

National Unit Specification: statement of standards

UNIT Product Design: Design Analysis (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Evaluate a commercial product.

Performance Criteria

- (a) Aspects to be included in the evaluation are identified and justified.
- (b) An appropriate strategy for evaluation is developed.
- (c) A comprehensive evaluation of the product is carried out.
- (d) Valid conclusions about the product are given.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

OUTCOME 2

Establish a design specification from a brief.

Performance Criteria

- (a) The brief is analysed and relevant design issues are identified.
- (b) The design issues are fully researched.
- (c) A detailed specification is derived from the design issues researched.

Evidence requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

National Unit Specification: statement of standards (cont)

UNIT Product Design: Design Analysis (Higher)

EVIDENCE REQUIREMENTS FOR THE UNIT

Evidence for this Unit can be written or oral, and graphical. The evidence should be produced under supervised conditions. Candidates are required to produce a folio of work which provides evidence for all Outcomes. The evidence may consist of work produced in response to a single task or a number of smaller tasks. The evidence will be produced as a natural part of the teaching and learning process.

The type of evidence will depend on the task undertaken. The folio of work is likely to include a mixture of the following:

- ◆ text, handwritten or word-processed
- ◆ graphics, manual or computer generated
- ◆ images, from a variety of sources.

Centres must be satisfied that the evidence submitted is the work of individual candidates. Although group work may be used as a learning and teaching approach, any work which contributes to a candidate's folio for assessment must be carried out on an individual basis.

Unit achievement is determined by the use of a cut-off score. The standard to be applied is detailed in the National Assessment Bank item available for the Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Product Design: Design Analysis (Higher)

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit focuses on the initial stages of the design process: investigating problems and setting out criteria for the solution. However, it is important that these stages are set in the context of the full design process. Candidates will, therefore, have to be made aware of the complete design process and the people involved in it. Candidates will also have to be made aware of the issues which affect the design of products.

The Course content which is likely to be covered in this Unit is detailed below:

Members of a design team:	Designers, market researchers, accountants, engineers, manufacturers. Relationships between team members. Types of teams.
Problem identification:	Situation analysis, product evaluation.
Brief:	Purpose, statement of problem, target market.
Research:	Sources of recorded and non-recorded information, methods of gathering information. Analysis and presentation of researched material.
Specification:	Types and purpose of specifications: brief, product design specification, performance specification, marketing specification and technical specification. Application of researched material to produce a product design specification.
Evaluation:	Surveys, questionnaires, user trips/trials, observation, testing, test rigs, comparison to other products, comparison to specification. Application of evaluation techniques, presentation of results.
Function:	Primary and secondary functions, fitness for purpose.
Performance:	Planned obsolescence, value for money, ease of maintenance, environmental concerns. Materials and manufacturing processes may be touched on in this Unit but are likely to be covered more fully in Unit 3.
Market:	Consumer demands, social expectations, niche marketing, branding, introduction of new products.

National Unit Specification: support notes (cont)

UNIT Product Design: Design Analysis (Higher)

Aesthetics:	Factors influencing aesthetics, influences of fashion, market trends, style.
Ergonomics:	Anthropometrics, psychology, physiology.
Economics:	Costs (fixed and variable), safety (British Standards, kite marks), market opportunity, intellectual property rights (confidentiality, patents, copyrights, design rights, trademarks, registered designs), value for money. Production systems may be touched on in this Unit but are likely to be covered more fully in Unit 3.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The context for delivery of the Unit will vary from centre to centre depending on the candidate group, centre facilities and staff expertise and interests.

Centres may choose to cover the two Outcomes with two separate tasks or to carry the same task across the two Outcomes.

For Outcome 1, it is likely that candidates will carry out a practical investigation, looking at products which are of interest to them and producing an evaluation.

For Outcome 2, candidates may wish to investigate their context, situation, task or problem of their own choice, however this will require teacher/lecturer guidance to ensure there is enough scope involved. If centres set a brief for candidates they should ensure that it is not 'too closed' but should select a context, task or problem which will leave sufficient scope for candidates to carry out research and draw up a specification.

Centres may choose to cover both Outcomes by adopting a 'reverse engineering' approach, analysing existing products and looking for ways of improving them. This must also allow candidates enough scope to fully analyse the situation and identify the problem.

Although group work may be used as a learning and teaching approach any work which contributes to a candidate's folio for assessment must be carried out on an individual basis.

The Course Arrangements give further information on teaching and learning in a Course context. It should be noted that there are areas of content in the Course which are not directly assessed within the Unit but are covered in the external Course assessment.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

This Unit gives candidates experience of design activity. Although candidates will develop their knowledge and understanding of design issues, Unit assessment is focused on the application of this knowledge and understanding.

National Unit Specification: support notes (cont)

UNIT Product Design: Design Analysis (Higher)

Candidates should gather a folio of work which will provide evidence across all the Outcomes. The standard to be applied is detailed in the National Assessment Bank item for the Unit.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT	Product Design: Developing Design Proposals (Higher)
NUMBER	DF4W 12
COURSE	Product Design (Higher)

SUMMARY

In this Unit candidates generate and develop ideas to satisfy a specification and work toward a solution through design activity. Candidates will apply design knowledge to develop ideas and will communicate and justify decisions taken in reaching a potential solution. Candidates will use written, graphical and modelling techniques to convey their ideas and produce a potential solution. The Unit is suitable for candidates with previous experience in related subjects (such as Craft and Design, Graphic Communication or Art and Design). It is also suitable as an introduction for candidates studying product design for the first time.

OUTCOMES

1. Produce a design proposal.
2. Use graphic techniques during the production of a design proposal.
3. Use modelling techniques during the production of a design proposal.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have achieved one of the following or equivalent:

- ◆ Standard Grade Craft and Design at Credit level
- ◆ Standard Grade Graphic Communication at Credit level
- ◆ Standard Grade Art and Design at Credit level
- ◆ The Unit *Product Design: Developing Design Proposals* at Intermediate 2

Administrative Information

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National Unit Specification: general information (cont)

UNIT Product Design: Developing Design Proposals (Higher)

CREDIT VALUE

1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skills components in this Unit.

National Unit Specification: statement of standards

UNIT Product Design: Developing Design Proposals (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Produce a design proposal.

Performance Criteria

- (a) A wide range of alternative ideas is generated and developed.
- (b) A design proposal is reached through the application of design knowledge.
- (c) Decisions made in reaching the design proposal are recorded and justified.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

OUTCOME 2

Use graphic techniques during the production of a design proposal.

Performance Criteria

- (a) A range of types of drawings and sketches is produced.
- (b) Drawings and sketches are used to effectively communicate the development of ideas and the design proposal.
- (c) Rendering skills are used to effectively communicate the development of ideas and the design proposal.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

OUTCOME 3

Use modelling techniques during the production of a design proposal.

Performance Criteria

- (a) A range of types of model is produced.
- (b) Practical skills are used effectively.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

National Unit Specification: statement of standards (cont)

UNIT Product Design: Developing Design Proposals (Higher)

EVIDENCE REQUIREMENTS FOR THE UNIT

Evidence for this Unit can be written or oral, and graphical. The evidence should be produced under supervised conditions. Candidates are required to produce a folio of work which provides evidence for all Outcomes. The evidence may consist of work produced in response to a single task or a number of smaller tasks. This evidence will be produced as a natural part of the teaching and learning process.

The folio of work will include a mixture of the following:

- ◆ text to communicate the main features of the design proposal
- ◆ a number of different types of graphic techniques to convey ideas
- ◆ photographs or computer images to show a range of models.

Centres must be satisfied that the evidence submitted is the work of individual candidates. Although group work may be used as a learning and teaching approach, any work which contributes to a candidate's folio for assessment must be carried out on an individual basis.

Achievement is decided by the use of a cut-off score. The standard to be applied is detailed in the National Assessment Bank item available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Product Design: Developing Design Proposals (Higher)

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit allows the candidate to develop design proposals which will meet a specification. The context is one of creative practical activity where candidates have the opportunity to enhance their design, graphic and modelling skills.

The Course content which is likely to be covered in this Unit is detailed below:

Idea generation:	Morphological analysis, thought sharers, technology transfer, analogy, lateral thinking. Application of idea generation techniques.
Development and refinement of ideas:	Application of knowledge and understanding. Synthesis of ideas. Justification and recording of decisions taken. Presentation techniques. Modelling techniques.
Graphic techniques:	Annotated sketches, working drawings, isometric, oblique, one point and two point perspective, exploded views, dimensioned views, illustration techniques, computer aided graphics, use of scale. The role of graphics in the design process. Use of graphic techniques to develop and communicate ideas.
Range of modelling techniques and materials:	Scale models, mock-ups, fully crafted prototypes, test models, computer generated models, part product models, simulations, rapid prototyping. Use of appropriate modelling materials such as paper, card, corrugated card, MDF, wire, pipe cleaners, foam, clay, plasticine, balsa wood, expanded foam, sheet plastic, construction kits. The role of modelling in the design process. Application of modelling techniques to develop and communicate ideas.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit should be based around practical design task(s). Practical activities may range from producing concept sketches on paper, quick modelling of ideas through to production of full-scale prototypes using more traditional craft skills. Centres are encouraged to deliver the Unit using practical activities which interest candidates.

National Unit Specification: support notes (cont)

UNIT Product Design: Developing Design Proposals (Higher)

Centres may wish to carry on from the work undertaken in Unit 1 and use the design specification as a starting point for this Unit. Alternatively, if the specification produced in Unit 1 does not offer sufficient scope for development or this Unit is being taken as a freestanding Unit, centres may need to supply candidates with a specification that offers sufficient opportunity to cover the Outcomes of this Unit.

Centres may choose to cover the three Outcomes with separate tasks but it is recommended that the selected product or situation for this Unit remains the same to encourage and focus the candidate's creative thinking.

Although group work may be used as a learning and teaching approach, any work which contributes to a candidate's folio for assessment must be carried out on an individual basis.

The Course Arrangements give further information on teaching and learning in a Course context. It should be noted that there are areas of content in the Course which are not directly assessed within the Unit but are covered in the external Course assessment.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

This Unit gives candidates experience of practical problem solving activities. Although candidates will develop their knowledge and understanding of techniques to generate and develop ideas, Unit assessment is focused on the practical application of these techniques.

Candidates should gather a folio of work which will provide evidence for all of the Outcomes. The standard to be applied is detailed in the National Assessment Bank item available for the Unit.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).

National Unit Specification: general information

UNIT	Product Design: Manufacturing Products (Higher)
NUMBER	DF4X 12
COURSE	Product Design (Higher)

SUMMARY

In this Unit candidates will develop knowledge and understanding of commercial manufacturing processes, systems and materials and why they are used for particular products. Candidates will also produce an orthographic drawing to convey information required for the manufacture of products. The Unit is suitable for candidates with previous experience in related subjects (such as Craft and Design, Graphic Communication or Art and Design). It is also suitable as an introduction for candidates studying product design for the first time.

OUTCOMES

1. Explain why particular materials are used for the manufacture of commercial products.
2. Explain why particular processes and systems are used for the manufacture of commercial products.
3. Produce an orthographic drawing suitable for use in the manufacture of a given product.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have achieved one of the following or equivalent:

- ◆ Standard Grade Craft and Design at Credit level
- ◆ Standard Grade Graphic Communication at Credit level
- ◆ The Unit *Product Design: Manufacturing Products* at Intermediate 2

Administrative Information

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National Unit Specification: general information (cont)

UNIT Product Design: Manufacturing Products (Higher)

CREDIT VALUE

1 credit at Higher (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills or Core Skills components in this Unit.

National Unit Specification: statement of standards

UNIT Product Design: Manufacturing Products (Higher)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Explain why particular materials are used for the manufacture of commercial products.

Performance Criteria

- (a) Materials used to manufacture given products are correctly identified.
- (b) Valid reasons are given to justify the identification of materials.
- (c) A valid explanation is given of why materials are suitable for the given products.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

OUTCOME 2

Explain why particular processes and systems are used for the manufacture of commercial products.

Performance Criteria

- (a) Processes and systems used to manufacture given products are correctly identified.
- (b) Valid reasons are given to justify the identification of processes.
- (c) A valid explanation is given of why processes are suitable for the given products.

Evidence Requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

OUTCOME 3

Produce an orthographic drawing suitable for use in the manufacture of a given product.

Performance Criteria

- (a) A complete and accurate orthographic drawing is produced.
- (b) Line type and dimensioning are correct.

Evidence requirements

(See Evidence Requirements for the Unit at the end of the statement of standards).

National Unit Specification: statement of standards (cont)

UNIT Product Design: Manufacturing Products (Higher)

EVIDENCE REQUIREMENTS FOR THE UNIT

Evidence for this Unit can be written or oral, and graphical. The evidence should be produced under supervised closed-book conditions. The assessments must be capable of being completed in one hour 30 minutes, and will cover all Outcomes.

For Outcomes 1 and 2, evidence is required in the form of responses to questions which test the knowledge and understanding outlined in the PCs.

For Outcome 3, the candidate will be required to produce an orthographic drawing.

Achievement is decided by the use of a cut-off score. The standard to be applied is detailed in the National Assessment Bank items available for this Unit. If a centre wishes to design its own assessments for this Unit, they should be of a comparable standard.

National Unit Specification: support notes

UNIT Product Design: Manufacturing Products (Higher)

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit focuses on the planning for manufacture of commercial products and the materials and processes used for manufacture. Candidates will consider why particular materials and processes are chosen for commercial products.

The Course content which is likely to be covered in this Unit is detailed below:

Plastics:	Polythene (high and low density), polyvinyl chloride, polystyrene, nylon, cellulose acetate, acrylic, polypropylene, ABS, epoxy resin, melamine formaldehyde, urea formaldehyde, polyester resin, glass-reinforced plastic, carbon-fibre plastics, elastomers.
Metals:	Mild steel, high carbon steel, stainless steel, high-speed steel, cast iron, brass, bronze, duralumin, aluminium, copper, tin, lead, zinc.
Woods:	Beech, oak, ash, mahogany, teak, walnut, balsa, Scots pine, red cedar, parana pine, spruce.
Timber derivatives:	Manufactured boards (medium density fibreboard, plywood, blockboard, chipboard, hardboard), veneer.
Identification of materials:	Colour, surface texture, weight, properties, labelling and symbols.
Plastic processes:	Injection-moulding, extrusion, rotational moulding, vacuum-forming, blow-moulding, laminating, joining, compression moulding, finishing.
Metal process:	Turning, milling, die-casting, pressing, stamping, punching, joining (spot welding, arc welding, riveting, adhesives, fitted joints, bolts, screws, patent devices), sand casting, casting, piercing and blanking, forging, finishing.
Wood processes:	Turning, routing, spindle moulding, laminating, jointing, finishing.
Identification of processes:	Form, material, split lines, injection points, ejector points, shrinkage, draft angle, intricate form, clean and precise, flash, thinning of sheet material at corners, shear marks, cross-section over length, surface texture.
Production systems:	One-off, batch, mass, line, flow. Gantt charts, flow charts, project planning, JIT, jigs, patterns, standard components, CAD/CAM, CNC machining.
Orthographic drawing	Elevation, end elevation, plan, outline, hidden detail, centre-line, dimensioning, section, hatch lines — all to BS conventions.

National Unit Specification: support notes (cont)

UNIT Product Design: Manufacturing Products (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Candidates should be introduced to materials and processes through the examination of actual products. Candidates should have access to suitable commercially manufactured products throughout the Unit.

Candidates should be given enough opportunity to develop orthographic drawing skills to prepare them for the Outcome 3 assessment.

Centres may wish to ask candidates to consider the commercial manufacture of the product which has been designed in Unit 2 as a method of covering the learning and teaching for all three Outcomes.

The Course Arrangements give further information on teaching and learning in a Course context. It should be noted that there are areas of content in the Course which are not directly assessed within the Unit but are covered in the external Course assessment.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

There are two types of evidence required in this Unit. Outcomes 1 and 2 require responses to questions on materials and processes. Outcome 3 requires the production of an orthographic drawing. Centres may wish to teach and assess materials and processes separately from orthographic drawing.

The standard to be applied is detailed in the National Assessment bank items available for this Unit.

SPECIAL NEEDS

This Unit Specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, September, 2003).