



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design

R105, R106, R107, R108

A comprehensive 99 page overview of how the following qualifications match to the Learning Outcomes for Cambridge National in Engineering, Principles in Engineering and Engineering Business showing opportunities for holistic teaching.

21st Century Physics A 2012 J245

21st Century Science A 2012 J241

21st Century Additional Science A 2012 J242

Gateway Additional Science B 2012 J262

Gateway Physics B 2012 J265

Gateway Science B 2012 J261

GCSE Mathematics B J567 Foundation Bronze

GCSE Mathematics B J567 Foundation Gold

GCSE Mathematics B J567 Foundation Initial

GCSE Mathematics B J567 Foundation Silver

GCSE Mathematics B J567 Higher Silver

Cambridge National ICT Level 1/2 J800/J810/J820

The suggested matches in this document are not definitive. They are examples of where Maths, Science and ICT can be applied in Cambridge National in Engineering Design.

You can navigate this pdf by clicking on any of the outer tabs on the unit pages. The Home button will return you to the Contents page.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841 – Maths, Science and ICT in Engineering

Cambridge National in Engineering - Mapping to (maths) and science

This document will help you plan your curriculum and assist you in delivering related subjects such as maths, science and ICT when teaching your Cambridge National in Engineering.

The mapping of R105 LO1 to maths foundation – initial and bronze

The example below is an extract from this mapping document and suggests how GCSE maths could be taught and then applied to develop skills in evaluating market data necessary for LO1.

Initial

Incorporates

- F1A5** Construct and interpret simple graphs, including conversion graphs.
- F1S4** Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data.
- F1S5** Extract and use information from common two-way tables including timetables.

Learners are required to interpret data that will influence a design idea (R105) which will require them to make comparisons of relevant data and perhaps present them visually. In maths, (F1S4) learners are required to draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data, then F1S5) extract and use information from common two-way tables including timetables. Joining these two requirements together makes the learning experience much more relevant to learners and should ultimately increase their interest.





CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841 – Maths, Science and ICT in Engineering

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	LO3	LO3 } Higher Silver	LO3	LO3
				LO4 } Higher Silver Higher Gold
Additional Science	R105	R106	R107	R108
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	LO3	LO3	LO3	LO3
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CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO1: Understand the design cycle and the relationship between design briefs and design specifications

Learners must be taught:

- **the design cycle , ie**
 - identify phase
 - design phase
 - optimise phase (eg virtual; physical)
 - validate phase (eg virtual; physical)
- **identification of design needs, ie**
 - initial design brief from the client
 - information which may inform the design brief
- **the relationship between a design brief and a design specification, ie**
 - client provides initial brief
 - discussion between client and designer (eg what is possible, what can be done within budget, essential and desirable aspects, timeframes)
 - further research (if required)
 - 'final' brief from which design specification will be developed

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Initial

Theme

Be able to interpret data (market research) used to influence the design process.[Direct]

Incorporates

FIA5 Construct and interpret simple graphs, including conversion graphs.

FIS4 Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data.

FIS5 Extract and use information from common two-way tables including timetables.

Extended opportunities



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Foundation
Initial

Foundation
Bronze

Foundation
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Foundation Bronze – GCSE Mathematics B J567

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Theme

Be able to interpret data (market research) used to influence the design process.[Direct]

Incorporates

FBA5 Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs.

FBS3 Construct and interpret pie charts.

FBS4 Interpret graphs representing real data, including recognising misleading diagrams.



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– Maths, Science and ICT in Engineering

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Foundation
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Foundation
Bronze

Foundation
Silver

Foundation
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Foundation Silver – GCSE Mathematics B J567

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Theme

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FSS3 Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range.



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Engineering Design J831/J841

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Foundation
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Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

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Theme

Be able to interpret data (market research) used to influence the design process.[Direct]

Incorporates

FGA5 Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.

FGS3 Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation. Look at data to find patterns and exceptions.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO2: Understand the requirements of design specifications for the development of a new product

Learners must be taught:

- **requirements of a design specification, ie**
 - user needs
 - product requirements
 - manufacturing considerations
 - production costs
 - regulations and safeguards

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Theme	Incorporates
Understands tolerances in engineering designs and materials. [Direct]	FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments.
	FIG2 Make sensible estimates of a range of measures in everyday settings.
Understands tolerances in engineering designs and materials. [Indirect]	FIN1 Round numbers to a given power of 10.
	FIN2 Add and subtract three-digit numbers, without the use of a calculator Add and subtract using numbers with up to two decimal places without the use of a calculator.
	FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.
	FIN4 Multiply and divide a three-digit number by a two-digit number. Multiply numbers with up to two decimal places by an integer.
Understand and interpret production costs in relation to design. [Direct]	FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape.
	FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator
	FIA5 Construct and interpret simple graphs, including conversion graphs.
	FIS4 Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data.
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CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

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Foundation
Initial

Foundation
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Foundation Bronze – GCSE Mathematics B J567

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Theme	Incorporates
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Understands tolerances in engineering designs and materials. [Indirect]	<p>FBN8 Use the four operations with positive and negative integers.</p> <p>FBN9 Use simple proportion, particularly in the context of recipes.</p>
Understand and interpret production costs in relation to design. [Direct]	<p>FBA5 Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs.</p> <p>FBS3 Construct and interpret pie charts.</p> <p>FBS4 Interpret graphs representing real data, including recognising misleading diagrams.</p>



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– Maths, Science and ICT in Engineering

Unit R105

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Theme	Incorporates
Understands tolerances in engineering designs and materials. [Direct]	
Understands tolerances in engineering designs and materials. [Indirect]	<p>FSN4 Use the four operations on decimals without the use of a calculator.</p> <p>FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.</p> <p>FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.</p>
Understand and interpret production costs in relation to design. [Direct]	<p>FSS3 Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range.</p>



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Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Theme	Incorporates
Understands tolerances in engineering designs and materials. [Direct]	
Understands tolerances in engineering designs and materials. [Indirect]	<p>FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.</p> <p>FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.</p>
Understand and interpret production costs in relation to design. [Direct]	<p>FGA5 Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.</p> <p>FGS3 Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation.</p> <p>Look at data to find patterns and exceptions.</p>



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Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO3: Know about the wider influences on the design of new products

Learners must be taught:

- **wider influences on new products, ie**
 - market pull / technological push
 - cultural and fashion trends
 - legislative design requirements (eg signs and symbols for materials products and safety issues)
 - links to inspirational / iconic products (eg copying successful ideas)
 - Life Cycle Analysis (LCA)
 - sustainable design (eg renewable resources, resource depletion, energy efficiency, disposal)
 - new and emerging technologies and materials
 - environmental pressures (eg ethical and socially responsible design)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs



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Engineering Design J831/J841

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Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Theme	Incorporates
Be able to interpret data (market research) used to influence the design process. [Indirect]	<p>HSS1 Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.</p> <p>HSS2 Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range.</p>



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Engineering Design J831/J841

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Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Theme	Incorporates
Be able to interpret data (market research) used to influence the design process. [Indirect]	HGS2 Draw and interpret histograms for grouped data. Understand frequency density.
	HGS3 Interpret and compare a wide range of data sets (including grouped discrete and continuous data) and draw conclusions.



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R105

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Cambridge National in ICT: J800/J810/J820

Keywords/Themes Market research (surveys), Improvements in materials, Budgets – budgeting

Theme	Incorporates	Theme comments
Market research as part of design needs [Direct]	<p>R001 (M)</p> <p>LO1: Understand how ICT can be used to meet business needs</p> <p>R002 (M)</p> <p>LO1: Be able to use techniques to search for, store and share information</p>	Use ICT to research and present information that might affect design needs (eg market needs, competitors products, materials and production processes)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learners must be taught:

- **commercial production methods that impact on product /component design, ie**
 - production
 - automation
- **impact of manufacturing processes on product design, ie**
 - moulding
 - pressing, forming
 - material shaping (eg CNC applications, CAM)
 - machining
 - finishing
 - assembly
- **considerations for product end of life, ie**
 - recycling materials
 - reusing components
 - safe disposal of toxic and hazardous materials
- **importance of conformity to legislation, quality and safety standards, ie**
 - British Standards (BS)
 - European Conformity (CE)
 - Waste Electrical and Electronic Equipment Directive (WEEE)
 - patents
 - copyright

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO2: Be able to research existing products

Learners must be taught:

- **research methods used to inform product analysis, ie**
 - primary research (eg physical analysis of products, questioning and surveying users)
 - secondary research sources (eg internet and online sources, books, literature, manuals, images, drawings)
- **strengths and weaknesses of existing products (eg finish, aesthetics, suitability to meet user needs, materials used, durability, sustainability, life cycle, energy use, power sources)**
- **methods used to summarise research outcomes ie**
 - charts/diagrams/tables
 - digital evidence
 - sketches/annotations

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Materials used, Sustainability, Energy and power sources

Theme

Understand research methods used to explore existing products. [Direct]

Incorporates

FIA5 Construct and interpret simple graphs, including conversion graphs.

FIS4 Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data.

FIS5 Extract and use information from common two-way tables including timetables.

Extended
opportunities



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Foundation Bronze – GCSE Mathematics B J567

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Foundation Silver – GCSE Mathematics B J567

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Mathematics B J567
Higher Silver

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CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO3: Be able to analyse an existing product through disassembly

Learners must be taught:

- **the use of sources and procedures for disassembly** (eg manufacturer's maintenance instructions/manual; follow structured procedure for disassembly)
- **disassembly procedures using appropriate tools and instruments safely** (eg screwdrivers, pliers, cutters, spanners, measuring equipment)
- **analyse an existing product through disassembly, ie**
 - components (eg standard, special) and their functions
 - assembly methods (eg mounting, connections)
 - materials
 - production methods
 - maintenance considerations

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial, Bronze, Silver and Gold

– GCSE Mathematics B J567

Extended opportunities



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– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO3: Be able to analyse an existing product through disassembly

Learners must be taught:

- **the use of sources and procedures for disassembly (eg manufacturer's maintenance instructions/manual; follow structured procedure for disassembly)**
- **disassembly procedures using appropriate tools and instruments safely (eg screwdrivers, pliers, cutters, spanners, measuring equipment)**
- **analyse an existing product through disassembly, ie**
 - components (eg standard, special) and their functions
 - assembly methods (eg mounting, connections)
 - materials
 - production methods
 - maintenance considerations

Mathematics B J567
Higher Silver

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Materials used, Sustainability, Energy and power sources

Theme	Incorporates
Understand research methods used to explore existing products. [Indirect]	<p>HSS1 Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.</p> <p>HSS2 Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learners must be taught:

- **commercial production methods that impact on product / component design, ie**
 - production
 - automation
- **impact of manufacturing processes on product design, ie**
 - moulding
 - pressing, forming
 - material shaping (eg CNC applications, CAM)
 - machining
 - finishing
 - assembly
- **considerations for product end of life, ie**
 - recycling materials
 - reusing components
 - safe disposal of toxic and hazardous materials
- **importance of conformity to legislation, quality and safety standards, ie**
 - British Standards (BS)
 - European Conformity (CE)
 - Waste Electrical and Electronic Equipment Directive (WEEE)
 - patents
 - copyright

Cambridge National in ICT: J800/J810/J820

Keywords/Themes Safe disposal toxic materials, CNC/CAM – materials shaping

Theme	Incorporates	Theme comments
CNC and CAM in product analysis [Indirect]	<p>R008 (T)</p> <p>LO1: Be able to devise algorithms to solve problems</p> <p>LO2: Be able to develop computer programs</p> <p>LO3: Be able to test and evaluate computer programs</p>	Appreciate the use of ICT in computer aided manufacture (CAM) and computer numeric control (CNC) when analysing manufacturing processes



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO2: Be able to research existing products

Learners must be taught:

- **research methods used to inform product analysis, ie**
 - primary research (eg physical analysis of products, questioning and surveying users)
 - secondary research sources (eg internet and online sources, books, literature, manuals, images, drawings)
- **strengths and weaknesses of existing products (eg finish, aesthetics, suitability to meet user needs, materials used, durability, sustainability, life cycle, energy use, power sources)**
- **methods used to summarise research outcomes ie**
 - charts/diagrams/tables
 - digital evidence
 - sketches/annotations

Cambridge National in ICT: J800/J810/J820

Keywords/Themes Materials used, Sustainability, Energy and power sources, Research methods: primary/secondary: internet

Theme	Incorporates	Theme comments
Research methods to inform product analysis [Direct]	<p>R001 (M)</p> <p>LO1: Understand how ICT can be used to meet business needs</p> <p>R002 (M)</p> <p>LO1: Be able to use techniques to search for, store and share information</p>	Understand the application of ICT in searching for and presenting primary and secondary research data to inform product analysis



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO1: Be able to generate design proposals using a range of techniques

Learners must be taught:

- **hand-drawing techniques to design and present ideas and concepts, ie**
 - freehand sketching in 2D and 3D
 - rendering using shade, tone and texture
- **annotation and labelling techniques that demonstrate design ideas (eg show key features, functions, dimensions, materials, construction/manufacture methods, access to components, areas for further investigation)**
- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Dimensions, Materials, Manufacturing methods

Theme	Incorporates
Understands dimensioning of engineering drawings used in design. [Direct]	FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments
	FIG2 Make sensible estimates of a range of measures in everyday settings
Understands dimensioning of engineering drawings used in design. [Indirect]	FIN1 Round numbers to a given power of 10
	FIN2 Add and subtract three-digit numbers, without the use of a calculator Add and subtract using numbers with up to two decimal places without the use of a calculator
	FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.
	FIN4 Multiply and divide a three-digit number by a two-digit number Multiply numbers with up to two decimal places by an integer
	FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape
	FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

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- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Bronze – GCSE Mathematics B J567

Keywords/Themes Dimensions, Materials, Manufacturing methods

Theme	Incorporates
Understands dimensioning of engineering drawings used in design. [Direct]	
Understands dimensioning of engineering drawings used in design. [Indirect]	<p>FBN8 Use the four operations with positive and negative integers</p> <p>FBN9 Use simple proportion, particularly in the context of recipes</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Dimensions, Materials, Manufacturing methods

Theme	Incorporates
Understands dimensioning of engineering drawings used in design. [Direct]	
Understands dimensioning of engineering drawings used in design. [Indirect]	<p>FSN4 Use the four operations on decimals without the use of a calculator.</p> <p>FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.</p> <p>FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

Keywords/Themes Dimensions, Materials, Manufacturing methods

Theme	Incorporates
Understands dimensioning of engineering drawings used in design. [Direct]	
Understands dimensioning of engineering drawings used in design. [Indirect]	<p>FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.</p> <p>FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO2: Know how to develop designs using engineering drawing techniques and annotation

Learners must be taught:

- **techniques to produce technical drawings, ie**
 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Drawing, Scale, Dimensions, Materials

Theme	Incorporates
Understands key drawing features of scale and dimensions. [Direct]	FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments.
	FIG2 Make sensible estimates of a range of measures in everyday settings.
Understands key drawing features of scale and dimensions. [Indirect]	FIN1 Round numbers to a given power of 10.
	FIN2 Add and subtract three-digit numbers, without the use of a calculator Add and subtract using numbers with up to two decimal places without the use of a calculator.
	FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.
	FIN4 Multiply and divide a three-digit number by a two-digit number. Multiply numbers with up to two decimal places by an integer.
	FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape.
	FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Bronze – GCSE Mathematics B J567

Keywords/Themes Drawing, Scale, Dimensions, Materials

Theme

Understands key drawing features of scale and dimensions.
[Direct]

Incorporates

FBG6 Construct and interpret maps and scale drawings, including estimating distances and areas.
Understand and use bearings to specify direction.

Understands key drawing features of scale and dimensions.
[Indirect]

FBN8 Use the four operations with positive and negative integers.

FBN9 Use simple proportion, particularly in the context of recipes.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Drawing, Scale, Dimensions, Materials

Theme	Incorporates
Understands key drawing features of scale and dimensions. [Direct]	
Understands key drawing features of scale and dimensions. [Indirect]	<p>FSN4 Use the four operations on decimals without the use of a calculator.</p> <p>FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.</p> <p>FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

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 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

Keywords/Themes Drawing, Scale, Dimensions, Materials

Theme	Incorporates
Understands key drawing features of scale and dimensions. [Direct]	
Understands key drawing features of scale and dimensions. [Indirect]	<p>FGN4 Use percentages to compare proportion. Use and find percentage change.</p> <p>FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.</p> <p>FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO3: Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals

Learners must be taught:

- CAD applications to produce and communicate design proposals (eg draughting, 3D modelling, rendering, assemblies, animation)
- techniques used to communicate design proposals (eg display boards, models, PowerPoint)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Bronze – GCSE Mathematics B J567

Keywords/Themes CAD drawing

Theme

Knows about features of engineering CAD drawings. [Direct]

Incorporates

FBG6 Construct and interpret maps and scale drawings, including estimating distances and areas. Understand and use bearings to specify direction.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

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Learners must be taught:

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- techniques used to communicate design proposals (eg display boards, models, PowerPoint)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial, Silver and Gold – GCSE Mathematics B J567

Keywords/Themes CAD drawing

Theme

Knows about features of engineering CAD drawings. [Direct]

Incorporates

FBG6 Construct and interpret maps and scale drawings, including estimating distances and areas. Understand and use bearings to specify direction.



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO1: Be able to generate design proposals using a range of techniques

Learners must be taught:

- **hand-drawing techniques to design and present ideas and concepts, ie**
 - freehand sketching in 2D and 3D
 - rendering using shade, tone and texture
- **annotation and labelling techniques that demonstrate design ideas (eg show key features, functions, dimensions, materials, construction/manufacture methods, access to components, areas for further investigation)**
- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Cambridge National in ICT: J800/J810/J820

Keywords/Themes Dimensions, Materials, Manufacturing methods, ICT software: drawings

Theme	Incorporates	Theme comments
Computer aided design (CAD) [Direct]	R006 (C) LO1: Be able to specify a digital image solution for a client's needs LO2: Be able to create digital images LO3: Be able to store, retrieve and present digital images	Be able to use ICT software to produce, modify and enrich design proposals



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO2: Know how to develop designs using engineering drawing techniques and annotation

Learners must be taught:

- **techniques to produce technical drawings, ie**
 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Cambridge National in ICT: J800/J810/J820

Keywords/Themes Dimensions, Materials, Manufacturing methods, ICT software: drawings

Theme	Incorporates	Theme comments
Computer aided design (CAD) [Direct]	<p>R006 (C)</p> <p>LO1: Be able to specify a digital image solution for a client's needs</p> <p>LO2: Be able to create digital images</p> <p>LO3: Be able to store, retrieve and present digital images</p>	Be able to use ICT software to produce, modify and enrich design proposals, including both 2D and 3D techniques



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO3: Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals

Learners must be taught:

- **CAD applications to produce and communicate design proposals (eg draughting, 3D modelling, rendering, assemblies, animation)**
- **techniques used to communicate design proposals (eg display boards, models, PowerPoint)**

Cambridge National in ICT: J800/J810/J820

Keywords/Themes CAD drawing, **ICT software: drawings, Communication: PowerPoint**

Theme	Incorporates	Theme comments
Computer aided design (CAD) [Direct]	<p>R006 (C)</p> <p>LO1: Be able to specify a digital image solution for a client's needs</p> <p>LO2: Be able to create digital images</p> <p>LO3: Be able to store, retrieve and present digital images</p>	Be able to use ICT (CAD applications) to produce and communicate design proposals
Presenting information [Direct]	<p>R002 (M)</p> <p>LO3: Be able to select and use software to communicate information for a business purpose</p> <p>LO4: Be able to use software tools to format information</p>	Be able to use ICT techniques to communicate design proposals
Presenting information [Indirect]	<p>R007 (C)</p> <p>LO1: Be able to prepare for the production of dynamic products</p> <p>LO2: Be able to create dynamic products</p> <p>LO3: Be able to test functionality of dynamic products</p>	Be able to use advanced ICT presentation techniques to communicate design proposals



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

- **key considerations when making a prototype, ie**
 - interpretation of a product specification
 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme	Incorporates
Understands planning tools used in engineering design and prototype manufacture. [Direct]	FIA5 Construct and interpret simple graphs, including conversion graphs.
	FIS4 Draw and interpret simple frequency tables, charts, pictograms and bar charts for discrete data.
	FIS5 Extract and use information from common two-way tables including timetables.
Understands measurements in relation to design and prototypes. [Direct]	FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments.
	FIG2 Make sensible estimates of a range of measures in everyday settings.
Understands measurements in relation to design and prototypes. [Indirect]	FIN1 Round numbers to a given power of 10.
	FIN2 Add and subtract three-digit numbers, without the use of a calculator Add and subtract using numbers with up to two decimal places without the use of a calculator.
	FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.
	FIN4 Multiply and divide a three-digit number by a two-digit number. Multiply numbers with up to two decimal places by an integer.
	FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape.
FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator	

Extended opportunities



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

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 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme	Incorporates
Understands planning tools used in engineering design and prototype manufacture. [Direct]	FBA5 Interpret information presented in a range of linear and non-linear graphs, including travel (distance/time) graphs.
	FBS3 Construct and interpret pie charts.
	FBS4 Interpret graphs representing real data, including recognising misleading diagrams.
Understands measurements in relation to design and prototypes. [Direct]	
Understands measurements in relation to design and prototypes. [Indirect]	FBN8 Use the four operations with positive and negative integers.
	FBN9 Use simple proportion, particularly in the context of recipes.
	FBG8 Understand positive integer scale factors. Use such scale factors to produce scaled-up images on a grid without a specified centre. Understand that an enlarged shape is mathematically similar to the original shape. Understand and recognise the congruence of simple shapes.

Extended opportunities



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

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 - planning stages used in the making a prototype (eg processes testing, evaluation)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme

Incorporates

Understands planning tools used in engineering design and prototype manufacture. [Indirect]

FSS3 Draw and interpret a wide range of graphs and diagrams for discrete and continuous data, including frequency polygons and stem and leaf diagrams. Compare distributions and make inferences, using the shapes of the distributions and measures of average and range.

Understands measurements in relation to design and prototypes. [Direct]

Understands measurements in relation to design and prototypes. [Indirect]

FSN4 Use the four operations on decimals without the use of a calculator.

FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.

FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.

Extended opportunities



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

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Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme

Understands planning tools used in engineering design and prototype manufacture. [Indirect]

Incorporates

FGA5 Draw and interpret graphs modelling real situations, which may be nonlinear, including simple quadratic graphs.

FGS3 Draw and interpret scatter graphs for discrete and continuous variables, including using and understanding lines of best fit. Understand the vocabulary of correlation, including: positive, negative and zero correlation; weak, strong and moderate correlation.

Look at data to find patterns and exceptions.

Understands measurements in relation to design and prototypes. [Direct]

Understands measurements in relation to design and prototypes. [Indirect]

FGN4 Use percentages to compare proportion. Use and find percentage change.

FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.

FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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 - use of planning tools (eg Gantt chart, flow chart, tables)
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 - planning stages used in the making a prototype (eg processes testing, evaluation)

Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme	Incorporates
Understands planning tools used in engineering design and prototype manufacture. [Indirect]	HSS1 Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.
Understands measurements in relation to design and prototypes. [Direct]	HSS2 Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range.
Understands measurements in relation to design and prototypes. [Indirect]	



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
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 - planning stages used in the making a prototype (eg processes testing, evaluation)

Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Theme

Understands planning tools used in engineering design and prototype manufacture. [Indirect]

Understands measurements in relation to design and prototypes. [Direct]

Understands measurements in relation to design and prototypes. [Indirect]

Incorporates

HGS2 Draw and interpret histograms for grouped data. Understand frequency density.

HGS3 Interpret and compare a wide range of data sets (including grouped discrete and continuous data) and draw conclusions.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO2: Understand safe working practices used when making a prototype

Learners must be taught:

- identification and consideration of risks in production plans
- production and use of risk assessments for production activities
- how to assess hazards and take precautions when using tools and machines
- safe use of hand tools and machines
- use of personal protective equipment (PPE) during production processes
- safe working procedures when using materials, chemicals, finishes and solvents

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial, Bronze, Silver and Gold – GCSE Mathematics B J567



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO3: Be able to produce a prototype

Learners must be taught:

- selection and use of appropriate materials to produce a prototype (eg card, foam, foam board, plastics, metals, wood)
- use of tools and processes to cut and shape materials (eg marking out, cutting, including CAD/CAM applications, bending, wasting, moulding, rapid prototyping)
- use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)
- methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Materials selection, Marking out, cutting, measuring

Theme

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Direct]

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Indirect]

Incorporates

FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments.

FIG2 Make sensible estimates of a range of measures in everyday settings.

FIN1 Round numbers to a given power of 10.

FIN2 Add and subtract three-digit numbers, without the use of a calculator

Add and subtract using numbers with up to two decimal places without the use of a calculator.

FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.

FIN4 Multiply and divide a three-digit number by a two-digit number.

Multiply numbers with up to two decimal places by an integer.

FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape.

FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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- use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)
- methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Bronze – GCSE Mathematics B J567

Keywords/Themes Materials selection, Marking out, cutting, measuring

Theme

Incorporates

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Direct]

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Indirect]

FBN8 Use the four operations with positive and negative integers.

FBN9 Use simple proportion, particularly in the context of recipes.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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Learners must be taught:

- **selection and use of appropriate materials to produce a prototype (eg card, foam, foam board, plastics, metals, wood)**
- **use of tools and processes to cut and shape materials (eg marking out, cutting, including CAD/CAM applications, bending, wasting, moulding, rapid prototyping)**
- **use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)**
- **methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)**

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Materials selection, Marking out, cutting, measuring

Theme

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Direct]

Incorporates

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Indirect]

FSN4 Use the four operations on decimals without the use of a calculator.

FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.

FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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- **use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)**
- **methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)**

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

Keywords/Themes Materials selection, Marking out, cutting, measuring

Theme

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Direct]

Incorporates

Applies appropriate methods such as measuring and marking out when producing design prototypes. [Indirect]

FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.

FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Initial – GCSE Mathematics B J567

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Theme	Incorporates
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]	FIG1 Use: kilometres, metres, centimetres and millimetres; kilograms and grams; litres and millilitres. Convert measurements from one metric unit to another Interpret scales on a range of measuring instruments.
	FIG2 Make sensible estimates of a range of measures in everyday settings.
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]	FIN1 Round numbers to a given power of 10.
	FIN2 Add and subtract three-digit numbers, without the use of a calculator Add and subtract using numbers with up to two decimal places without the use of a calculator.
	FIN3 Multiply and divide numbers with no more than one decimal digit by an integer between 1 and 10, without the use of a calculator. Multiply and divide any number by 10, 100 and 1000 without the use of a calculator.
	FIN4 Multiply and divide a three-digit number by a two-digit number. Multiply numbers with up to two decimal places by an integer.
	FIN5 Calculate a fraction of a given quantity. Identify fractions of a shape.
FIN9 Solve problems using the four operations on integer and decimal numbers using a calculator	



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

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Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Bronze – GCSE Mathematics B J567

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Theme

Incorporates

Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]

Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]

FBN8 Use the four operations with positive and negative integers.

FBN9 Use simple proportion, particularly in the context of recipes.



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Silver – GCSE Mathematics B J567

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Theme	Incorporates
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]	
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]	<p>FSN4 Use the four operations on decimals without the use of a calculator.</p> <p>FSN5 Use ratio notation including reduction to its simplest form. Understand and use ratio and proportion, including dividing a quantity in a given ratio.</p> <p>FSN6 Use a calculator effectively and efficiently, entering a range of measures including 'time', interpreting the display and rounding off a final answer to a reasonable degree of accuracy. Perform calculations using the order of operations.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Foundation
Initial

Foundation
Bronze

Foundation
Silver

Foundation
Gold

Foundation Gold – GCSE Mathematics B J567

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Theme	Incorporates
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]	
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]	<p>FGG1 Recognise that a measurement given to the nearest whole unit may be inaccurate by up to one half of a unit in either direction.</p> <p>FGG7 Recognise, visualise and construct enlargements of objects using positive integer scale factors and a centre of enlargement. Identify the centre and the scale factor of an enlargement. Understand the implications of enlargement for perimeter/length.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Silver

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management

Precision, accuracy, quality

Theme	Incorporates
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]	
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]	<p>HSS1 Use tree diagrams to represent outcomes of combined events, recognising when events are independent. Find probabilities using tree diagrams.</p> <p>HSS2 Draw and interpret cumulative frequency tables and diagrams and box plots for grouped data. Find the median, quartiles and interquartile range.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Mathematics B J567
Higher Silver

Mathematics B J567
Higher Gold

Extended opportunities – GCSE Mathematics B J567 Higher Gold

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management

Precision, accuracy, quality

Theme	Incorporates
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Direct]	
Compares and evaluates designs against specification including precision, accuracy, time and resources. [Indirect]	<p>HGS2 Draw and interpret histograms for grouped data. Understand frequency density.</p> <p>HGS3 Interpret and compare a wide range of data sets (including grouped discrete and continuous data) and draw conclusions.</p>



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO1: Understand the design cycle and the relationship between design briefs and design specifications

Learners must be taught:

- **the design cycle , ie**
 - identify phase
 - design phase
 - optimise phase (eg virtual; physical)
 - validate phase (eg virtual; physical)
- **identification of design needs, ie**
 - initial design brief from the client
 - information which may inform the design brief
- **the relationship between a design brief and a design specification, ie**
 - client provides initial brief
 - discussion between client and designer (eg what is possible, what can be done within budget, essential and desirable aspects, timeframes)
 - further research (if required)
 - 'final' brief from which design specification will be developed

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Gateway Physics B 2012 J265

Theme

Understands how improvements in materials and technology influence design. [Direct]

Incorporates

C3h Chemical Economics (nanotubes and innovations)

P3f Forces for Transport (crumple zones – innovations)

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO2: Understand the requirements of design specifications for the development of a new product

Learners must be taught:

- **requirements of a design specification, ie**
 - user needs
 - product requirements
 - manufacturing considerations
 - production costs
 - regulations and safeguards

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Gateway Physics B 2012 J265

Theme

Understand how materials selected during design affect manufacturing. [Direct]

Incorporates

C4g Periodic Table

Understand how design affects sustainable manufacture. [Indirect]

C4g Radiation for Life (electrostatics – precipitators)

21st Century Physics A 2012 J245

Theme

Understand how materials selected during design affect manufacturing. [Direct]

Incorporates

C5.3/C5.4 Chemicals of the natural environment (metals)

Understand how design affects sustainable manufacture. [Indirect]



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO3: Know about the wider influences on the design of new products

Learners must be taught:

- **wider influences on new products, ie**
 - market pull / technological push
 - cultural and fashion trends
 - legislative design requirements (eg signs and symbols for materials products and safety issues)
 - links to inspirational / iconic products (eg copying successful ideas)
 - Life Cycle Analysis (LCA)
 - sustainable design (eg renewable resources, resource depletion, energy efficiency, disposal)
 - new and emerging technologies and materials
 - environmental pressures (eg ethical and socially responsible design)

Keywords/Themes Sustainable design and environmental, New technologies and materials

Gateway Physics B 2012 J265

Theme

Understand the relationship between design and environmental issues. [Indirect]

Incorporates

C4g Radiation for Life (electrostatics – precipitators)

Understand how design is influenced by new and emerging technologies including materials. [Direct]

C3h

Chemical Economics (nanotubes and innovations)

P3f

Forces for Transport (crumple zones – innovations)

C4g

Radiation for Life (electrostatics – paint coating)

Understand Life Cycle Analysis

21st Century Physics A 2012 J245

Theme

Understand how materials selected during design affect manufacturing. [Direct]

Incorporates

C5.3/C5.4

Chemicals of the natural environment (metals)

Understand how design affects sustainable manufacture. [Indirect]



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learners must be taught:

- **commercial production methods that impact on product / component design, ie**
 - production
 - automation
- **impact of manufacturing processes on product design, ie**
 - moulding
 - pressing, forming
 - material shaping (eg CNC applications, CAM)
 - machining
 - finishing
 - assembly
- **considerations for product end of life, ie**
 - recycling materials
 - reusing components
 - safe disposal of toxic and hazardous materials
- **importance of conformity to legislation, quality and safety standards, ie**
 - British Standards (BS)
 - European Conformity (CE)
 - Waste Electrical and Electronic Equipment Directive (WEEE)
 - patents
 - copyright

Keywords/Themes Safe disposal toxic materials

Gateway Physics B 2012 J265

Theme

Appreciate the safe disposal of hazardous materials at end of life. [Direct]

Incorporates

Understand commercial production methods. [Direct]

C3g

Chemical Economics (batch and continuous manufacture)

21st Century Physics A 2012 J245

Theme

Appreciate the safe disposal of hazardous materials at end of life. [Direct]

Incorporates

C6.1

Chemicals and why we need them (safe use)

Understand commercial production methods. [Direct]



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO2: Be able to research existing products

Learners must be taught:

- **research methods used to inform product analysis, ie**
 - primary research (eg physical analysis of products, questioning and surveying users)
 - secondary research sources (eg internet and online sources, books, literature, manuals, images, drawings)
- **strengths and weaknesses of existing products (eg finish, aesthetics, suitability to meet user needs, materials used, durability, sustainability, life cycle, energy use, power sources)**
- **methods used to summarise research outcomes ie**
 - charts/diagrams/tables
 - digital evidence
 - sketches/annotations

Keywords/Themes Materials used, Sustainability, Energy and power sources

Gateway Physics B 2012 J265

Theme

Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]

Incorporates

C3h Chemical Economics (nanotubes and innovations)

P3f Forces for Transport (crumple zones – innovations)

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO3: Be able to analyse an existing product through disassembly

Learners must be taught:

- **the use of sources and procedures for disassembly (eg manufacturer's maintenance instructions/manual; follow structured procedure for disassembly)**
- **disassembly procedures using appropriate tools and instruments safely (eg screwdrivers, pliers, cutters, spanners, measuring equipment)**
- **analyse an existing product through disassembly, ie**
 - components (eg standard, special) and their functions
 - assembly methods (eg mounting, connections)
 - materials
 - production methods
 - maintenance considerations

Keywords/Themes Materials

Gateway Physics B 2012 J265

Theme

Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]

Incorporates

C3h Chemical Economics (nanotubes and innovations)

P3f Forces for Transport (crumple zones – innovations)

P4g Radiation for Life (use of radiation for treatment – innovations)

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO1: Be able to generate design proposals using a range of techniques

Learners must be taught:

- **hand-drawing techniques to design and present ideas and concepts, ie**
 - freehand sketching in 2D and 3D
 - rendering using shade, tone and texture
- **annotation and labelling techniques that demonstrate design ideas (eg show key features, functions, dimensions, materials, construction/manufacture methods, access to components, areas for further investigation)**
- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Keywords/Themes Dimensions, Materials, Manufacturing methods

Gateway Physics B 2012 J265

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

C4g The Periodic Table (metals)

21st Century Physics A 2012 J245

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

C5.3/C5.4 Chemicals of the natural environment (metals)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO2: Know how to develop designs using engineering drawing techniques and annotation

Learners must be taught:

- **techniques to produce technical drawings, ie**
 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Keywords/Themes Drawing, Scale, Dimensions, Materials

Gateway Physics B 2012 J265

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

C4g The Periodic Table (metals)

21st Century Physics A 2012 J245

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

C5.3/C5.4 Chemicals of the natural environment (metals)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO3: Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals

Learners must be taught:

- CAD applications to produce and communicate design proposals (eg draughting, 3D modelling, rendering, assemblies, animation)
- techniques used to communicate design proposals (eg display boards, models, PowerPoint)

Keywords/Themes CAD drawing

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

- **key considerations when making a prototype, ie**
 - interpretation of a product specification
 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Gateway Physics B 2012 J265

Theme

Be able to plan the making of a prototype considering material resources required. [Direct]

Incorporates

C4g The Periodic Table (metals)

21st Century Physics A 2012 J245

Theme

Be able to plan the making of a prototype considering material resources required. [Direct]

Incorporates

C5.3/C5.4 Chemicals of the natural environment (metals)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO2: Understand safe working practices used when making a prototype

Learners must be taught:

- identification and consideration of risks in production plans
- production and use of risk assessments for production activities
- how to assess hazards and take precautions when using tools and machines
- safe use of hand tools and machines
- use of personal protective equipment (PPE) during production processes
- safe working procedures when using materials, chemicals, finishes and solvents

Keywords/Themes Safe working (chemicals)

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

Theme

Understand safe working when making a prototype including safe use of chemicals. [Direct]

Incorporates

C6.1 Chemicals and why we need them (safe use)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO3: Be able to produce a prototype

Learners must be taught:

- selection and use of appropriate materials to produce a prototype (eg card, foam, foam board, plastics, metals, wood)
- use of tools and processes to cut and shape materials (eg marking out, cutting, including CAD/CAM applications, bending, wasting, moulding, rapid prototyping)
- use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)
- methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)

Keywords/Themes Materials selection, Marking out, cutting, measuring

Gateway Physics B 2012 J265

Theme

Be able to select appropriate materials to make a design prototype. [Direct]

Incorporates

C4g The Periodic Table (metals)

21st Century Physics A 2012 J245

Theme

Understand safe working when making a prototype including safe use of chemicals. [Direct]

Incorporates

C6.1 Chemicals and why we need them (safe use)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Gateway Physics B 2012 J265

Theme

Be able to evaluate materials and methods used in making a prototype. [Indirect]

Incorporates

- | | |
|------------|---|
| P4d | Radiation for Life (Ultrasound – use for testing) |
| P4h | Radiation for Life (Radioisotopes – use for testing) |
| P4g | Radiation for Life (use of radiation for treatment – use for testing) |

21st Century Physics A 2012 J245

Theme

Be able to evaluate materials and methods used in making a prototype. [Indirect]

Incorporates

- | | |
|-------------|---|
| P6.2 | Radioactive materials (use for testing) |
|-------------|---|



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO1: Understand the design cycle and the relationship between design briefs and design specifications

Learners must be taught:

- **the design cycle , ie**
 - identify phase
 - design phase
 - optimise phase (eg virtual; physical)
 - validate phase (eg virtual; physical)
- **identification of design needs, ie**
 - initial design brief from the client
 - information which may inform the design brief
- **the relationship between a design brief and a design specification, ie**
 - client provides initial brief
 - discussion between client and designer (eg what is possible, what can be done within budget, essential and desirable aspects, timeframes)
 - further research (if required)
 - 'final' brief from which design specification will be developed

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Gateway Physics B 2012 J265

Theme

Understands how improvements in materials and technology influence design. [Direct]

Incorporates

P3f Crumple zones

P5a/P5e Satellites, gravity and circular motion (satellites – innovation)

P5g Refraction of waves (innovations – cat's eyes etc)

21st Century Physics A 2012 J245

Theme

Understands how improvements in materials and technology influence design. [Direct]

Incorporates

P2.2, P2.4 Radiation for life (innovations)

P6.2 Radioactive materials (innovations)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO2: Understand the requirements of design specifications for the development of a new product

Learners must be taught:

- **requirements of a design specification, ie**
 - user needs
 - product requirements
 - manufacturing considerations
 - production costs
 - regulations and safeguards

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Gateway Physics B 2012 J265

Theme

Understand how materials selected during design affect manufacturing.

Understand how design affects sustainable manufacture. [Direct]

Incorporates

- | | |
|------------|--|
| P1h | Stable Earth (ozone) |
| P2a | Collecting energy from the Sun |
| P2b | Generating electricity |
| P2c | Global warming |
| P2d | Fuels for power |
| P2e | Nuclear radiations |
| P4h | Fission and fusion (energy generation) |

21st Century Physics A 2012 J245

Theme

Understand how materials selected during design affect manufacturing.

Understand how design affects sustainable manufacture. [Direct]

Incorporates

- | | |
|-------------|---|
| P2.3 | Radiation and life (global warming) |
| P3.3 | Sustainable energy |
| P7.5 | Further Physics – Studying the Universe (building observatories – sustainability) |



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO3: Know about the wider influences on the design of new products

Learners must be taught:

- **wider influences on new products, ie**
 - market pull / technological push
 - cultural and fashion trends
 - legislative design requirements (eg signs and symbols for materials products and safety issues)
 - links to inspirational / iconic products (eg copying successful ideas)
 - Life Cycle Analysis (LCA)
 - sustainable design (eg renewable resources, resource depletion, energy efficiency, disposal)
 - new and emerging technologies and materials
 - environmental pressures (eg ethical and socially responsible design)

Keywords/Themes Sustainable design and environmental, New technologies and materials

Gateway Physics B 2012 J265

Theme

Understand the relationship between design and environmental issues. [Direct]

Understand how design is influenced by new and emerging technologies including materials. [Direct]

Incorporates

P1h Stable Earth (ozone)

P2a Collecting energy from the Sun

P2b Generating electricity

P2c Global warming

P3f Crumple zones

P5a/P5e Satellites, gravity and circular motion

P5g Refraction of waves (innovations – cat's eyes etc)

P2d Fuels for power

P2e Nuclear radiations

P4h Fission and fusion (energy generation)

21st Century Physics A 2012 J245

Theme

Understand the relationship between design and environmental issues. [Direct]

Understand how design is influenced by new and emerging technologies including materials. [Direct]

Incorporates

P2.3 Radiation and life (global warming)

P3.3 Sustainable energy

P7.5 Further Physics – Studying the Universe (building observatories – sustainability)

P2.2, P2.4 Radiation for life (innovations)

P6.2 Radioactive materials (innovations)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learners must be taught:

- **commercial production methods that impact on product /component design, ie**
 - production
 - automation
- **impact of manufacturing processes on product design, ie**
 - moulding
 - pressing, forming
 - material shaping (eg CNC applications, CAM)
 - machining
 - finishing
 - assembly
- **considerations for product end of life, ie**
 - recycling materials
 - reusing components
 - safe disposal of toxic and hazardous materials
- **importance of conformity to legislation, quality and safety standards, ie**
 - British Standards (BS)
 - European Conformity (CE)
 - Waste Electrical and Electronic Equipment Directive (WEEE)
 - patents
 - copyright

Keywords/Themes Materials used, Sustainability, Energy and power sources

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO2: Be able to research existing products

Learners must be taught:

- **research methods used to inform product analysis, ie**
 - primary research (eg physical analysis of products, questioning and surveying users)
 - secondary research sources (eg internet and online sources, books, literature, manuals, images, drawings)
- **strengths and weaknesses of existing products (eg finish, aesthetics, suitability to meet user needs, materials used, durability, sustainability, life cycle, energy use, power sources)**
- **methods used to summarise research outcomes ie**
 - charts/diagrams/tables
 - digital evidence
 - sketches/annotations

Keywords/Themes Sustainable design and environmental, New technologies and materials

Gateway Physics B 2012 J265

Theme

Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]

Understand strengths and weaknesses of existing products, including energy use. [Direct]

Incorporates

P3f Crumple zones

P5a/P5e Satellites, gravity and circular motion (satellites – innovation)

P5g Refraction of waves (innovations – cat's eyes etc)

P1h Stable Earth (ozone)

P2a Collecting energy from the Sun

P2b Generating electricity

P2c Global warming

P2d Fuels for power

P2e Nuclear radiations

P4h Fission and fusion (energy generation)

21st Century Physics A 2012 J245

Theme

Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]

Understand strengths and weaknesses of existing products, including energy use. [Direct]

Incorporates

P2.2, P2.4 Radiation for life (innovations)

P6.2 Radioactive materials (innovations)

P2.3 Radiation and life (global warming)

P3.3 Sustainable energy



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO3: Be able to analyse an existing product through disassembly

Learners must be taught:

- **the use of sources and procedures for disassembly (eg manufacturer's maintenance instructions/manual; follow structured procedure for disassembly)**
- **disassembly procedures using appropriate tools and instruments safely (eg screwdrivers, pliers, cutters, spanners, measuring equipment)**
- **analyse an existing product through disassembly, ie**
 - components (eg standard, special) and their functions
 - assembly methods (eg mounting, connections)
 - materials
 - production methods
 - maintenance considerations

Keywords/Themes Materials

Gateway Physics B 2012 J265

Theme

Be able to analyse products through disassembly, including materials used. [Indirect]

Incorporates

P3f Crumple zones

P5a/P5e Satellites, gravity and circular motion (satellites – innovation)

P5g Refraction of waves (innovations – cat's eyes etc)

21st Century Physics A 2012 J245

Theme

Be able to analyse products through disassembly, including materials used. [Indirect]

Incorporates

P2.2, P2.4 Radiation for life (innovations)

P6.2 Radioactive materials (innovations)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO1: Be able to generate design proposals using a range of techniques

Learners must be taught:

- **hand-drawing techniques to design and present ideas and concepts, ie**
 - freehand sketching in 2D and 3D
 - rendering using shade, tone and texture
- **annotation and labelling techniques that demonstrate design ideas (eg show key features, functions, dimensions, materials, construction/manufacture methods, access to components, areas for further investigation)**
- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Keywords/Themes Dimensions, Materials, Manufacturing methods

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO2: Know how to develop designs using engineering drawing techniques and annotation

Learners must be taught:

- **techniques to produce technical drawings, ie**
 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Keywords/Themes Drawing, Scale, Dimensions, Materials

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO3: Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals

Learners must be taught:

- CAD applications to produce and communicate design proposals (eg draughting, 3D modelling, rendering, assemblies, animation)
- techniques used to communicate design proposals (eg display boards, models, PowerPoint)

Keywords/Themes CAD drawing

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

- **key considerations when making a prototype, ie**
 - interpretation of a product specification
 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO2: Understand safe working practices used when making a prototype

Learners must be taught:

- identification and consideration of risks in production plans
- production and use of risk assessments for production activities
- how to assess hazards and take precautions when using tools and machines
- safe use of hand tools and machines
- use of personal protective equipment (PPE) during production processes
- safe working procedures when using materials, chemicals, finishes and solvents

Keywords/Themes Safe working (chemicals)

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO3: Be able to produce a prototype

Learners must be taught:

- selection and use of appropriate materials to produce a prototype (eg card, foam, foam board, plastics, metals, wood)
- use of tools and processes to cut and shape materials (eg marking out, cutting, including CAD/CAM applications, bending, wasting, moulding, rapid prototyping)
- use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)
- methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)

Keywords/Themes Materials selection, Marking out, cutting, measuring

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Gateway Physics B 2012 J265

Theme

Be able to evaluate materials and methods used in making a prototype.
[Indirect]

Incorporates

P4f Uses of radioisotopes (used for testing)

21st Century Physics A 2012 J245

Theme

Be able to evaluate materials and methods used in making a prototype.
[Indirect]

Incorporates

P2.2, P2.4 Radiation for life (used for testing)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO1: Understand the design cycle and the relationship between design briefs and design specifications

Learners must be taught:

- **the design cycle , ie**
 - identify phase
 - design phase
 - optimise phase (eg virtual; physical)
 - validate phase (eg virtual; physical)
- **identification of design needs, ie**
 - initial design brief from the client
 - information which may inform the design brief
- **the relationship between a design brief and a design specification, ie**
 - client provides initial brief
 - discussion between client and designer (eg what is possible, what can be done within budget, essential and desirable aspects, timeframes)
 - further research (if required)
 - 'final' brief from which design specification will be developed

Keywords/Themes Market research (surveys), Improvements in materials, Budgets

Gateway Physics B 2012 J265

Theme

Understands how improvements in materials and technology influence design. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys
- C2d** Making cars

21st Century Physics A 2012 J245

Theme

Understands how improvements in materials and technology influence design. [Direct]

Incorporates

- C2.1, C2.2, C2.3, C2.4** Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO2: Understand the requirements of design specifications for the development of a new product

Learners must be taught:

- **requirements of a design specification, ie**
 - user needs
 - product requirements
 - manufacturing considerations
 - production costs
 - regulations and safeguards

Keywords/Themes Materials, Supply chain, Tolerances, Sustainability, Production costs

Gateway Physics B 2012 J265

Theme	Incorporates			
Understand how materials selected during design affect manufacturing. [Direct]	C1d	Making polymers	C2b	Construction materials
	C1e	Designer polymers	C2c	Metals and alloys
	C1h	Paints and pigments	C2d	Making cars
Understand how design affects sustainable manufacture. [Direct]	C1a	Making crude oil useful	P2c	Global warming
	P2b	Generating electricity	P2d	Fuels for power
			P2e	Nuclear radiations
			P1h	Stable Earth
		B2g	Population and pollution	
		B2h	Sustainability	

21st Century Physics A 2012 J245

Theme	Incorporates
Understand how materials selected during design affect manufacturing. [Direct]	C2.1, C2.2, C2.3, C2.4 Material Choices
Understand how design affects sustainable manufacture. [Direct]	C1.2, C1.2 Air Quality
	P2.2, P2.3 Radiation and life (Global Warming, Ozone layer)
	P3.1, P3.2, P3.3 Sustainable energy



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R105

Design briefs, design specifications and user requirements

LO3: Know about the wider influences on the design of new products

Learners must be taught:

- **wider influences on new products, ie**
 - market pull / technological push
 - cultural and fashion trends
 - legislative design requirements (eg signs and symbols for materials products and safety issues)
 - links to inspirational / iconic products (eg copying successful ideas)
 - Life Cycle Analysis (LCA)
 - sustainable design (eg renewable resources, resource depletion, energy efficiency, disposal)
 - new and emerging technologies and materials
 - environmental pressures (eg ethical and socially responsible design)

Keywords/Themes Sustainable design and environmental, New technologies and materials, Life Cycle Analysis

Gateway Physics B 2012 J265

Theme	Incorporates
Understand the relationship between design and environmental issues (including sustainable design). [Direct]	C1a Making crude oil useful
	C1b Using carbon fuels
	C1c Clean air
	P2a Collecting energy from the Sun
	P2b Generating electricity
Understand how design is influenced by new and emerging technologies including materials. [Direct]	P2c Global warming
	C1d Making polymers
	C2b Construction materials
Understand Life Cycle Analysis. [Direct]	C2c Metals and alloys
	C2d Making cars
Understand Life Cycle Analysis. [Direct]	P2d Fuels for power
	P2e Nuclear radiations
Understand Life Cycle Analysis. [Direct]	P1h Stable Earth
	B2g Population and pollution
Understand Life Cycle Analysis. [Direct]	B2h Sustainability
	C2d Making cars

21st Century Physics A 2012 J245

Theme	Incorporates
Understand how design is influenced by new and emerging technologies including materials. [Direct]	C2.1, C2.2, C2.3, C2.4 Material Choices
	C3.4 Chemicals in our lives – risks and benefits (Life Cycle Analysis)
Understand Life Cycle Analysis. [Direct]	



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learners must be taught:

- **commercial production methods that impact on product /component design, ie**
 - production
 - automation
- **impact of manufacturing processes on product design, ie**
 - moulding
 - pressing, forming
 - material shaping (eg CNC applications, CAM)
 - machining
 - finishing
 - assembly
- **considerations for product end of life, ie**
 - recycling materials
 - reusing components
 - safe disposal of toxic and hazardous materials
- **importance of conformity to legislation, quality and safety standards, ie**
 - British Standards (BS)
 - European Conformity (CE)
 - Waste Electrical and Electronic Equipment Directive (WEEE)
 - patents
 - copyright

Keywords/Themes Safe disposal toxic materials

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

Theme

Appreciate the safe disposal of hazardous materials at end of life.

Incorporates

C3.4 Chemicals in our lives – risks and benefits (Life Cycle Analysis)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO2: Be able to research existing products

Learners must be taught:

- **research methods used to inform product analysis, ie**
 - primary research (eg physical analysis of products, questioning and surveying users)
 - secondary research sources (eg internet and online sources, books, literature, manuals, images, drawings)
- **strengths and weaknesses of existing products (eg finish, aesthetics, suitability to meet user needs, materials used, durability, sustainability, life cycle, energy use, power sources)**
- **methods used to summarise research outcomes ie**
 - charts/diagrams/tables
 - digital evidence
 - sketches/annotations

Keywords/Themes Materials used, Sustainability, Energy and power sources

Gateway Physics B 2012 J265

Theme	Incorporates	
Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]	C1d	Making polymers
	C1e	Designer polymers
	C1h	Paints and pigments
Understand strengths and weaknesses of existing products, including energy use. [Direct]	C2b	Construction materials
	C2c	Metals and alloys
	C2d	Making cars
	P2b	Generating electricity
	P2c	Global warming
	P2d	Fuels for power
	P2e	Nuclear radiations
	P2a	Collecting energy from the Sun

21st Century Physics A 2012 J245

Theme	Incorporates	
Be able to research existing designs, including materials used, energy use, sustainability, life cycle and power sources. [Direct]	C2.1, C2.2, C2.3, C2.4 Material Choices	
	C1.2, C1.2	Air Quality
Understand strengths and weaknesses of existing products, including energy use. [Direct]	P2.2, P2.3	Radiation and life (Global Warming, Ozone layer)
	P3.1, P3.2, P3.3	Sustainable energy



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R106

Product analysis and research

LO3: Be able to analyse an existing product through disassembly

Learners must be taught:

- **the use of sources and procedures for disassembly (eg manufacturer's maintenance instructions/manual; follow structured procedure for disassembly)**
- **disassembly procedures using appropriate tools and instruments safely (eg screwdrivers, pliers, cutters, spanners, measuring equipment)**
- **analyse an existing product through disassembly, ie**
 - components (eg standard, special) and their functions
 - assembly methods (eg mounting, connections)
 - materials
 - production methods
 - maintenance considerations

Keywords/Themes Materials

Gateway Physics B 2012 J265

Theme

Be able to analyse products through disassembly, including materials used. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Be able to analyse products through disassembly, including materials used. [Direct]

Incorporates

C2.1, C2.2, C2.3, C2.4 Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO1: Be able to generate design proposals using a range of techniques

Learners must be taught:

- **hand-drawing techniques to design and present ideas and concepts, ie**
 - freehand sketching in 2D and 3D
 - rendering using shade, tone and texture
- **annotation and labelling techniques that demonstrate design ideas (eg show key features, functions, dimensions, materials, construction/manufacture methods, access to components, areas for further investigation)**
- **the use of ICT software to produce, modify and enrich design proposals (eg text, graphics)**

Keywords/Themes Dimensions, Materials, Manufacturing methods

Gateway Physics B 2012 J265

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Understand the application of materials in design proposals. [Direct]

Incorporates

C2.1, C2.2, C2.3, C2.4 Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO2: Know how to develop designs using engineering drawing techniques and annotation

Learners must be taught:

- **techniques to produce technical drawings, ie**
 - 3D engineering drawings (eg isometric and oblique, exploded views, assembly drawings)
 - 2D engineering drawings (eg 3rd angle orthographic, scale, dimensions, materials, parts lists, sectioned, relevant notes and annotations)

Keywords/Themes Drawing, Scale, Dimensions, Materials

Gateway Physics B 2012 J265

Theme

Be able to develop designs using a range of materials. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Be able to develop designs using a range of materials. [Direct]

Incorporates

C2.1, C2.2, C2.3, C2.4 Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R107

Developing and presenting engineering designs

LO3: Be able to use Computer Aided Design (CAD) software and techniques to produce and communicate design proposals

Learners must be taught:

- CAD applications to produce and communicate design proposals (eg draughting, 3D modelling, rendering, assemblies, animation)
- techniques used to communicate design proposals (eg display boards, models, PowerPoint)

Keywords/Themes CAD drawing

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

No learning outcomes can be mapped for 21st Century Physics A



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

- **key considerations when making a prototype, ie**
 - interpretation of a product specification
 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Keywords/Themes Planning tools (Gantt chart, flow chart, tables), Materials, Measuring

Gateway Physics B 2012 J265

Theme

Be able to plan the making of a prototype considering material resources required. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Be able to plan the making of a prototype considering material resources required. [Direct]

Incorporates

C2.1, C2.2, C2.3, C2.4 Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO2: Understand safe working practices used when making a prototype

Learners must be taught:

- identification and consideration of risks in production plans
- production and use of risk assessments for production activities
- how to assess hazards and take precautions when using tools and machines
- safe use of hand tools and machines
- use of personal protective equipment (PPE) during production processes
- safe working procedures when using materials, chemicals, finishes and solvents

Keywords/Themes Safe working (chemicals)

Gateway Physics B 2012 J265

No learning outcomes can be mapped for Gateway Physics B

21st Century Physics A 2012 J245

Theme

Understand safe working when making a prototype including safe use of chemicals. [Indirect]

Incorporates

C3.4 Chemicals in our lives – risks and benefits (Life Cycle Analysis)



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO3: Be able to produce a prototype

Learners must be taught:

- selection and use of appropriate materials to produce a prototype (eg card, foam, foam board, plastics, metals, wood)
- use of tools and processes to cut and shape materials (eg marking out, cutting, including CAD/CAM applications, bending, wasting, moulding, rapid prototyping)
- use of preparation and assembly methods (eg jigs, formers, templates, patterns, moulds, adhesives, temporary and permanent fixings)
- methods of recording key stages of making the prototype (eg note taking, keeping a production diary, photography capturing different stages of production, recording problems, technical difficulties and solutions)

Keywords/Themes Materials selection, Marking out, cutting, measuring

Gateway Physics B 2012 J265

Theme

Be able to select appropriate materials to make a design prototype. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Be able to select appropriate materials to make a design prototype. [Direct]

Incorporates

C2.1, C2.2, C2.3, C2.4 Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Engineering Design J831/J841

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO4: Be able to evaluate the success of a prototype

Learners must be taught:

- **how to evaluate a prototype, ie**
 - comparison of prototype and production plan against product specification
 - potential improvements in design
- **how to evaluate own performance, ie**
 - management of time and resources
 - planning and preparation
 - precision and accuracy achieved in making processes
 - quality of outcome

Keywords/Themes Comparing plan against spec, Materials improvements, Time/resources management, Precision, accuracy, quality

Gateway Physics B 2012 J265

Theme

Be able to evaluate materials and methods used in making a prototype. [Direct]

Incorporates

- C1d** Making polymers
- C1e** Designer polymers
- C1h** Paints and pigments
- C2b** Construction materials
- C2c** Metals and alloys

21st Century Physics A 2012 J245

Theme

Be able to evaluate materials and methods used in making a prototype. [Direct]

Incorporates

- C2.1, C2.2, C2.3, C2.4** Material Choices



CAMBRIDGE NATIONAL IN ENGINEERING

Systems Control in Engineering J833/J843

– Maths, Science and ICT in Engineering

Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

- **key considerations when making a prototype, ie**
 - interpretation of a product specification
 - processes for making a prototype model
 - use of planning tools (eg Gantt chart, flow chart, tables)
 - resources when making a prototype (eg materials, component parts, cutting lists, tools/equipment, health and safety requirements/hazards, time requirements)
 - planning stages used in the making a prototype (eg processes testing, evaluation)

Cambridge National in ICT: J800/J810/J820

Keywords/Themes Planning tools (Gantt chart, flow chart, tables) – for planning, Materials, Measuring

Theme	Incorporates	Theme comments
Using ICT for planning [Direct]	<p>R002 (M) LO2: Be able to select and use software to handle data</p> <p>R003 (B) LO1: Be able to create and populate spreadsheets to meet user requirements LO2: Be able to select and use spreadsheet functions to meet user requirements LO3: Be able to use spreadsheet models to present information to support decision making</p>	Use ICT tools to plan the making of a prototype (eg spreadsheets to produce Gantt charts, tables etc.)



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Unit R108

3D design realisation

LO1: Know how to plan the making of a prototype

Learners must be taught:

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 - interpretation of a product specification
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Cambridge National in Cambridge National in ICT: J800/J810/J820

Keywords/Themes Materials selection, Marking out, cutting, measuring, **Production: CAD/CAM applications**

Theme	Incorporates	Theme comments
Using CAD/CAM in making a prototype [Indirect]	R008 (T) LO1: Be able to devise algorithms to solve problems LO2: Be able to develop computer programs LO3: Be able to test and evaluate computer programs	Use ICT in the making of a prototype (eg CAD/CAM applications and programming, rapid prototype programming)

Maths GCSE

GCSE Mathematics is a tiered qualification comprising **Foundation, Initial, Bronze, Silver** and **Gold** and **Higher Initial, Higher Bronze, Higher Silver** and **Higher Gold**. A number of key mathematical themes directly and indirectly relevant to solving engineering problems are covered across tiers with increasing breadth and depth. Key themes include application of number, algebra, trigonometry and statistical analysis. Relevance to engineering problem solving includes producing and re-arranging equations and formulae, producing and interpreting graphs, understanding proportion, percentages, volumes and masses, and performing statistical operations.

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