



Blue Coat Church of England Academy

Year: 11

Subject: Engineering

Overview

Cambridge National in Engineering Design helps students understand the processes of engineering design and how market requirements inform client briefs. Through practical activities they develop skills in computer modelling and model making and how to communicate design ideas effectively.

Specification code: J831, J841

Qualification number: 601/1411/3

Performance table status: Included on 2020 performance tables

The Cambridge Nationals in Engineering Design encourage learners to communicate and consult with a client to develop a viable and innovative product. Learners will apply practical skills to produce a prototype in the form of a model and test design ideas to inform further product development. Through reflection learners evaluate the prototype, making a comparable outcome against specification points, and assess possible, practical solutions and improvements to their prototype design. A practical approach to teaching and learning will provide learners with knowledge in engineering technology and develop critical thinking, creativity and dextrous skills through engaging practical experiences.




Year 11 will focus upon the completion of R105 (examination) and R106 product analysis.

Term 1

Students will work towards completion of learning in preparation for early entry into the examination stage R105, this takes place in January 2020 should a student fail to achieve target grade these can then be re-entered in the July series. LO1, LO2.




Learning Outcome — The learner will:





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

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 The design cycle: identify and design phases 	Learners could use a product case study in order to explore the four stages of the design cycle: identify, design, optimise and validation. The first two stages involve devising the design brief, undertaking research, process planning, producing a specification, design, and producing manufacturing plans. Websites might prove useful to teachers for explaining the design cycle such as BBC Bitesize: http://www.bbc.co.uk/schools/gcsebitesize/design/systemscontrol/designevaluationrev1.shtml	2 hours	
2 The design cycle: optimise and validation phases 	The second two stages of the design cycle form a natural follow on in terms of optimising and validating a completed design. This often involves producing models and prototypes which are error proofed, tested and evaluated. The teacher might use websites which show and explain the design cycle (eg http://www.design-technology.info/designcycle/). A case study approach (such as the car or mobile phone) in which learner's research the application of the design cycle might prove a useful approach to developing understanding.	2 hours	
3 Identifying design needs: design briefs 	Teachers might be able to provide learners with initial design briefs for them to explain and analyse showing needs of the client (such as branding and audience) and purpose and functions of the product. Websites might prove useful in explaining the key features of a design brief, such as http://www.technologystudent.com/designpro/problem1.htm . Learners might be given the opportunity to write their own design briefs, working in groups, for a product idea given to them by the teacher or chosen by the group.	2 hours	

Learning Outcome — The learner will:

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

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Design specifications 	Learners may already have had the opportunity to explore design briefs before moving onto understanding and developing a full design specification. Website, such as BBC Bitesize, may prove useful in explaining the content of a typical product design specification (http://www.bbc.co.uk/schools/gcsebitesize/design/resistantmaterials/designanalysisevaluationrev3.shtml). Learners might begin by identifying user needs such as aesthetics, ergonomics, anthropometrics, benefits and features, and product safety. The teacher might develop a suitable case study approach undertaken as a group based activity.	2 hours	
2 Product requirements 	Learners might further develop their understanding of the content of a design brief by considering product function, features, performance, target group/intended users, working environment, limitations and constraints (size, weight, functional limitations), appearance, ergonomics and lifecycle. Again, the teacher might use a product case study around which learners can develop a design specification to incorporate some or all of these features.	2 hours	
3 Manufacturing considerations: materials and supply 	Materials availability and the management of a supply chain are an essential part of the product production process which should be considered at the design stage. Suitable videos, such as those here about the development, materials requirements and supply chain management for the Smart car might help with putting this into context (http://www.open.edu/openlearn/science-maths-technology/engineering-and-technology/supply-chains-smart-cars). Teachers might continue the case study approach by getting learners to research materials availability and the supply chain for a given or chosen product.	1 hour	R109 (LO1) R109 (LO4)




Suggested content	Suggested activities	Suggested timings	Possible relevance to
<p>4 Manufacturing considerations: ease of manufacture</p> 	<p>Further considerations at the design stage that impact on manufacturing are: ease of manufacture (using standard components or pre-manufactured components), design for manufacturing assembly (DFMA), design for assembly, and manufacturing processes. The teacher might introduce learners to these through developing or continuing a case study approach, or may be able to arrange an industrial visit where learners could talk to designers and manufacturing engineers.</p>	2 hours	R112 (LO4)
<p>5 Manufacturing considerations: scale, reliability, safety and sustainability</p> 	<p>Teachers might continue a case study approach to developing product specifications by introducing further manufacturing considerations such as scale of production including prototypes, one-off, batch and mass production. Suitable videos might be useful in showing and explaining commercial production techniques (such as http://www.youtube.com/watch?v=DTWnQDAhp9k which shows job, batch and flow production taking place). It might be possible to arrange an industrial visit where the whole product design process can be seen from design to manufacture. Further items the teacher might introduce include: durability, reliability, tolerances, product safety, sustainability, and maintenance as part of the design specification process.</p>	2 hours	R106 (LO1) R110 (LO3) R111 (LO1)
<p>6 Production costs</p> 	<p>The teacher might develop a group based activity in which learners have to research and estimate the production costs for a given item. Teachers could explain that production costs are made up of direct and indirect costs, and suitable websites might be used to explain this (eg http://businesscasestudies.co.uk/business-theory/finance/calculating-costs-of-production.html).</p> <p>The teacher might develop this activity by giving learners a product and direct costs (for materials and components) and indirect costs (for lighting, rent and salaries) in order to produce the product. See Lesson Element Production Costs.</p>	1 hour	
<p>7 Regulations and safeguards</p> 	<p>The teacher might begin by explaining the importance of product conformity with standards (such as British Standards, European Conformity (CE)). This might be further developed into explaining how a design can be protected using copyright, patents, registered designs and trademarks. Learners could be tasked to undertake research of a given product (such as the iPhone or Dyson vacuum cleaners) to see how its design is protected and how it conforms to standards.</p>	2 hours	



Term 2.1

Students will work towards completion of learning in preparation for early entry into the examination stage R105, this takes place in January 2020 should a student fail to achieve target grade these can then be re-entered in the July series. LO3

Learning Outcome — The learner will:

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

Suggested content	Suggested activities	Suggested timings	Possible relevance to
1 Market forces 	The teacher might use suitable websites to explain the role of market pull/technological push in the development of new products (eg http://www.bbc.co.uk/schools/gcsebitesize/design/resistantmaterials/designsocialrev1.shtml). Similarly, such websites might prove useful in explaining how cultural and fashion trends affect product development. Learners could be asked to identify research and explain a range of products that have resulted from market pull and technological push.	2 hours	
2 Legislation and design 	The teacher might begin by explaining how products are required to conform to legislative requirements – which include product safety and product and packaging labelling. In the UK products are supplied with a certificate of conformity, and this may be a useful starting point (http://www.hse.gov.uk/work-equipment-machinery/declaration-conformity.htm). Learners might undertake a research activity in order to investigate the impact of legislation on design, including how safety requirements are met and also the use of signage and symbols to indicate this on products and packaging.	2 hours	
3 Inspirational design and new materials technology 	The teacher could use web based resources to show how inspirational and iconic designs and how new and emerging technologies and materials have influenced the field of product design. Some examples include the Smart car: http://www.open.edu/openlearn/science-maths-technology/engineering-and-technology/supply-chains-smart-cars and the iPhone http://www.youtube.com/watch?v=Etyt4osHgX0 . Learners could undertake a research activity to identify and explain iconic and inspirational designs, and might be challenged to present and argue their top 10 choices to the rest of the class. The following website suggests a top 50 iconic designs, and could be used to start a debate: http://www.complex.com/art-design/2013/02/the-50-most-iconic-designs-of-everyday-objects/	2 hours	

Suggested content	Suggested activities	Suggested timings	Possible relevance to
4 Life Cycle Analysis 	<p>The teacher might use suitable web resources to explain Life Cycle Analysis (LCA) to learners such as http://www.powerhousemuseum.com/ecologic/resources/lesson-plans-worksheets/lesson-plan-product-life-cycle-analysis/#worksheet</p> <p>Learners could be given an activity, working in groups, to develop a LCA for an everyday product, such as the newspaper or mobile phone. The following website gives a graphical representation of such examples, and may prove useful: http://www.technologystudent.com/prddes1/lifecy1.html.</p> <p>The teacher might extend this activity by introducing the idea of products becoming obsolete as part of the life cycle of a product (e.g. the typewriter or Model T Ford). See Lesson Element Life Cycle Analysis.</p>	2 hours	R112 (LO4)
5 Environmental pressures 	<p>The teacher could introduce ethical and social design responsibility and the importance of sustainable design (e.g. renewable resources, resource depletion, energy efficiency, disposal) through suitable videos (eg http://www.youtube.com/watch?v=gmpdqOerOF4)</p> <p>Learners could research case studies, such as those in the following Royal Academy of Engineering document: http://www.raeng.org.uk/events/pdf/Engineering_for_Sustainable_Development.pdf</p> <p>Learners could then be asked to consider, in groups, how given manufacturers respond to these issues.</p>	2 hours	R112 (LO4)

Term 2.2

Students will carry out CAT R106 analysis of a product

Learning Outcome 1: Know how commercial production methods, quality and legislation impact on the design of products and components

Learning Outcome 2: Be able to research existing products

Scenario for the Assignment

Many householders experience problems with flooding due to burst pipes or extreme weather. Simple pumps that can be powered by an electric drill are widely available to help remove water from flooded areas. However, testing of some of these pumps has shown that they can fail to perform correctly.

You have been asked by a pump manufacturer to undertake product analysis of both its own and competitors pump products to establish the strengths and weaknesses of the designs.

You will also consider the factors that influence the design of these pump products.



Read through all of the tasks carefully, so that you know what you will need to do to complete this assignment.

Mark Band 1	Mark Band 2	Mark Band 3
LO1: Know how commercial production methods, quality and legislation impact on the design of products and components		
<p>Demonstrates limited knowledge of how commercial production methods and manufacturing processes impact on product/component design.</p> <p>Basic description of how product end of life considerations can influence product/component design.</p> <p>Demonstrates a limited knowledge of the importance of conformity to legislation and standards</p> <p>1 – 4 marks</p>	<p>Demonstrates some knowledge of how commercial production methods and manufacturing processes impact on product/component design.</p> <p>Describes in some detail how product end of life considerations can influence product/component design.</p> <p>Demonstrates a sound knowledge of the importance of conformity to legislation and standards</p> <p>5 – 8 marks</p>	<p>Demonstrates detailed knowledge of how commercial production methods and manufacturing processes impact on product/component design.</p> <p>Comprehensively describes how product end of life considerations can influence product/component design.</p> <p>Demonstrates detailed knowledge of the importance of conformity legislation and standards</p> <p>9 – 12 marks</p>
LO2: Be able to research existing products		
<p>Provides a basic description of strengths and weaknesses of existing products.</p> <p>Uses few appropriate methods to provide a brief summary of research of existing products.</p> <p>1 – 6 marks</p>	<p>Provides an adequate description of strengths and weaknesses of existing products.</p> <p>Uses some appropriate methods to provide a detailed summary of research of existing products.</p> <p>7 – 12 marks</p>	<p>Provides a comprehensive description of strengths and weaknesses of existing products.</p> <p>Uses appropriate methods to provide a comprehensive and detailed summary of research of existing products.</p> <p>13 – 18 marks</p>

Term 3

Students will carry out CAT R106 analysis of a product

Learning Outcome 3: Be able to analyse an existing product through disassembly

LO3: Be able to analyse an existing product through disassembly		
<p>Requires regular assistance to follow manufacturer's instructions/manual /disassembly procedure. Requires prompting to follow special instructions.</p> <p>With guidance uses tools and equipment safely and shows limited awareness of potential hazards and safety considerations.</p> <p>Draws upon limited skills/knowledge/ understanding from other units in the specification (Unit R105).</p> <p>1 – 6 marks</p>	<p>Works competently with occasional assistance to follow manufacturer's instructions/manual/disassembly procedure, mostly adhering to special instructions.</p> <p>Uses tools and equipment effectively and shows some understanding of potential hazards and safety considerations.</p> <p>Draws upon some relevant skills/knowledge/ understanding from other units in the specification (Unit R105).</p> <p>7 – 12 marks</p>	<p>Works independently and competently to follow manufacturer's instructions/manual /disassembly procedure, adhering to special instructions.</p> <p>Uses tools and equipment effectively and shows a well-developed understanding of potential hazards and safety considerations.</p> <p>Clearly draws upon relevant skills/knowledge/ understanding from other units in the specification (Unit R105).</p> <p>13 – 18 marks</p>
<p>Carries out a limited analysis of an existing product showing a basic understanding of some components, assembly methods, materials, production methods and maintenance.</p> <p>1 – 4 marks</p>	<p>Carries out a detailed analysis of an existing product showing an adequate understanding of components, assembly methods, materials, production methods and maintenance.</p> <p>5 – 8 marks</p>	<p>Carries out a comprehensive analysis of an existing product showing a well-developed understanding of components, assembly methods, materials, production methods and maintenance.</p> <p>9 –12 marks</p>