OCR
Oxford Cambridge and RSA

Cambridge **NATIONALS LEVEL 1/2**

ENGINEERING DESIGN

Cambridge NATIONALS

R106 Product analysis and research

J831/J841

Schemes of work

Version 1

CONTENTS

INTRODUCTION

This teaching resource, which we've developed with Nationals Engineering teachers, contains two types of schemes of work.

- A **longer term** plan which covers the whole academic year over three terms and suggests the order in which each Learning Outcome (LO) could be taught. Links to other units and LOs within Nationals Engineering are also shown.
- A **medium term** plan which also covers the whole academic year over three terms and suggests the order in which each LO could taught but also provides classroom activities and any links to other resources which might be useful. We've also included 'Have they got it?' linking to activities other LOs in this unit and/or other units and LOs within Nationals Engineering. This includes performing practical activities by which learners confirm their understanding.

Link to qualification

Cambridge Nationals Level 1/2 Engineering Design

See our range of planning and teaching resources including delivery guides, project approaches, teaching activities, teacher guides and resources lists.

See our range of assessment resources including past paper, mark schemes, examiners' reports, candidate exemplars and set assignments.

Scheme of work (longer term plan – academic year)

	Learning Outcome	Topic area/theme (from R106 specification)	Links to other Cambridge Nationals Engineering units and LOs
Autumn Term	**LO1**	Commercial production methods.	**R105 LO2** – Understand the requirements of design specifications for the development of a new product.
	LO1	Impact of manufacturing processes (hand tools).	**R105 LO2** – Understand the requirements of design specifications for the development of a new product. **R109 LO2** – Understand engineering processes and their application.
	LO1	Impact of manufacturing processes (machine tools).	**R105 LO2** – Understand the requirements of design specifications for the development of a new product. **R109 LO2 –** Understand engineering processes and their application.
	LO1	Impact of manufacturing processes (production at scale).	**R105 LO2 –** Understand the requirements of design specifications for the development of a new product. **R109 LO2** – Understand engineering processes and their application.
	LO1	Impact of manufacturing processes (computer aided manufacture).	**R105 LO3** – Know about the wider influences on the design of new products. **R111 LO4 –** Know about applications of computer control processes used to manufacture products.
	LO1	End of life considerations.	**R105 LO3** – Know about the wider influences on the design of new products.
	LO1	End of life considerations.	**R105 LO3** – Know about the wider influences on the design of new products.
	LO1	Conformity to legislation (safety).	**R105 LO3** – Know about the wider influences on the design of new products.
	LO1	Conformity to legislation (protection).	**R105 LO3** – Know about the wider influences on the design of new products.
	LO1	Impact of production and legislation on a product.	

	Learning Outcome	Topic area/theme (from R106 specification)	Links to other Cambridge Nationals Engineering units and LOs
Spring Term	**LO2**	Primary research (analysing a product).	**R105 LO3** – Know about the wider influences on the design of new products.
	LO2	Primary research (surveying and questioning users).	**R105 LO1** – Understand the design cycle and the relationship between design briefs and design specifications.
	LO2	Secondary research.	**R105 LO1** – Understand the design cycle and the relationship between design briefs and design specifications.
	LO2	Recording research.	
	LO2	Strengths and weaknesses (material properties).	**R105 LO2** – Understand the requirements of design specifications for the development of a new product. **R109 LO1** – Know about properties and uses of engineering materials.
	LO2	Strengths and weaknesses (finish, aesthetics, durability, sustainability, life cycle, energy use, power sources).	**R105 LO2** – Understand the requirements of design specifications for the development of a new product. **R109 LO1** – Know about properties and uses of engineering materials.
	LO2	Strengths and weaknesses (suitability for users).	**R105 LO2** – Understand the requirements of design specifications for the development of a new product.
	LO2	Charts and diagrams.	
	LO2	Annotated sketching.	**R107 LO1** – Be able to generate design proposals using a range of techniques.
	LO2	Researching an existing product.	

	Learning Outcome	Topic area/theme (from R106 specification)	Links to other Cambridge Nationals Engineering units and LOs
Summer Term	**LO3**	Structured procedures for disassembly - use of manuals and guides.	
	LO3	Guidance for recording disassembly.	
	LO3	Safe us of tool – guidance.	**R108 LO2** – Understand safe working practices used when making a prototype. **R110 LO2** – Be able to use processes, tools and equipment safely to make a pre-production product.
	LO3	Disassembly procedures.	**R108 LO1** – Know how to plan the making of a prototype.
	LO3	Analysing a product: components.	**R105 LO2** – Understand the requirements of design specifications for the development of a new product.
	LO3	Analysing a product: assembly method.	**R105 LO2** – Understand the requirements of design specifications for the development of a new product.
	LO3	Analysing a product: material choice.	**R105 LO2** – Understand the requirements of design specifications for the development of a new product.
	LO3	Analysing a product: production methods and manufacturing processes.	**R105 LO1** – Understand the design cycle and the relationship between design briefs and design specifications.
	LO3	Analysing a product: maintenance considerations.	**R105 LO3** – Know about the wider influences on the design of new products.
	LO3	Disassembling an existing product.	

Scheme of work (medium term plan – more detailed by academic term)

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	1	LO1	Commercial production methods.	Learners could be introduced to scales of production: one-off, batch and mass production (for R106 there is no need to consider prototyping). They could link example products with likely scales of production. Learners could then justify why they believe that product is manufactured using that scale and the impact this has on cost and quality. Learners should be made aware of the misconception that mass production does not necessarily mean lower quality. Learners could look at partially automated processes e.g. cars / electronic products and identify how these have assisted the manufacture of products.	Learners will be able analyse existing products or components in terms of scale of production. They will be able to explain how scale of production has impacted the product e.g. quantity, quality and cost.	Go to www.stem.org.uk and search for 'scales of production' for a range of resources on different production methods.
	2	LO1	Impact of manufacturing processes (hand tool).	Learners could be introduced to a range of hand tools and identify their type and the function they perform. Learners could be given example components or products that have been manufactured using hand tools and explain the processes involved. Learners could undertake focused practical tasks to use a range of hand tools to understand how they function and results they produce. In consolidation learners could discuss the advantages/ disadvantages hand tool processes have in a producing commercial products or components.	Learners will be able to analyse a product or component in terms of manufacturing processes that have been used for its manufacture. Learners will be able to explain how materials can be shaped and formed using a range of common hand tools and be able to recognise its application.	wiki.dtonline.org has introductory guides to a wide range of hand tools and their application.

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	**3**	**LO1**	Impact of manufacturing processes (machine tools).	Learners could be introduced to a range of machine tools and identify their type and the function they perform. Learners could be given example components or products that have been manufactured using machine tools and explain the processes involved. Learners could undertake focused practical tasks to use a range of machine tools to understand the function and results they produce. In consolidation learners could discuss the advantages/ disadvantages machine tools provide.	Learners will be able to analyse a product or component in terms of manufacturing processes that have been used for its manufacture. Learners will be able to explain how materials can be shaped and formed using a range of machine tools and be able to recognise where these processes have been used.	BBC Bitesize has guides and videos to using a range of common hand tools and machines. Alternatively, search YouTube for machine tools such as 'pillar drill', 'lathe' or 'milling machine'.
	4	**LO1**	Impact of manufacturing processes (production at scale).	Learners could continue to research manufacturing processes by being introduced to a range of processes that are typically used in large scale production and which are repeatable e.g. injection moulding, blow moulding, casting. Learners could research products typically manufactured using these processes. Learners could be led in discussion of the advantages and disadvantages of each of these processes.	Learners will be able to analyse a product or component in terms of manufacturing processes. Learners will be able to explain how materials can be shaped and formed using a range of processes.	Go to www.bpf.co.uk/plastipedia/processes/default aspx for a range of guides on plastics production at scale.
	5	**LO1**	Impact of manufacturing processes (computer aided manufacture).	Learners could be introduced to processes that enable computer aided manufacture. Learners could research a range of processes e.g. CNC milling, laser cutting or 3D printing. Learners could undertake a practical activity using some of these processes and be asked to analyse the advantages they provide.	Learners will be able to analyse a product or component in terms of manufacturing processes used in its manufacture. Learners will be able to explain how materials can be shaped and formed using a range of computer-controlled processes.	

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	**6**	**LO1**	End of life considerations.	Learners could begin by sorting materials into recyclable and non-recyclable. Learners could research which materials can be recycled easily and the cost/impact of doing so, sharing this information with each other. Learners could then look at example disassembled products and identify how much of the product could be recycled or repurposed.	Learners will be able to analyse products in terms of recycling and reusing. They will be able to assess the ease of recycling based on a range of factors e.g. ease of disassembly, choice of materials and potential for repurposing.	www.recycling-guide.org.uk/ has a simple guide to which materials can be recycled. YouTube has a wealth of videos documenting the recycling process for most materials.
	7	**LO1**	End of life considerations.	Learners could be introduced to a variety of products that require specialist disposal at the end of their life e.g. batteries, electrical equipment, Learners could be asked to research and produce a chart or guidance leaflet for reference. Learners could research and explain why the history and purpose of the WEEE directive.	Learners will be aware of special end of life considerations for disposal where materials are considered hazardous. Learners will be able to identify whether these apply to specific products.	HSE guide contains a guide to the WEEE directive. Go to Goverment website and search for 'classify different types of waste' for a list of products with special disposal considerations.
	8	**LO1**	Conformity to legislation (safety).	Learners could be introduced to British Standards and CE markings. Learners could research and produce an explanation of the purpose of these standards and markings. Learners could research some common product standards and use the titles to explain which may apply to example products.	Learners will be able to explain the impact of product standards and CE markings on a product. Learners will be able to suggest, based on research, the standards that may be relevant to a given product.	BSI worldwide sites provides information on the British Standards Institution (BSI), the use of product standards and CE certification. HSE website contains a more detailed guide of safety legislation for products or equipment involving machinery.

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Autumn Term	**9**	**LO1**	Conformity to legislation (protection).	Learners could be introduced to the terms patent, trademark and copyright and be asked to identify how they provide protection. Learners could look at case studies of famous patents and research the life of a patent and what happens afterwards. Learners could analyse a product or component and research any associated trademarks, copyright and patents.	Learners will be able to explain the impact of trademarks and copyright on the protection of a product or trading name. Learners will be able to explain how registered designs and patent protect the ideas behind a product and its features. Learners will be able to relate this to physical products.	Go to Copyright Alliance website and search for 'difference between copyright, patent and trademark' www.gov.uk/browse/business/intellectual-property has guides to types of protection.
	10	**LO1**	Impact of production and legislation on a product.	Learners could be given a simple product e.g. a bike light, and asked to practice all the skills learnt so far in LO1. Learners could be provided with headings to guide them and asked to report back on their findings. This should, where possible, be clearly linked to the design of the product.	Learners will be able to describe the impact of production method, manufacturing processes and legislation on a given product, clearly relating this to the design of the product.	

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	1	LO2	Primary research (analysing a product).	Learners could be introduced to the idea of primary and secondary research. Learners could be provided with a list of different research types and be asked to sort them into primary and secondary research. Learners could identify the advantages of primary research over secondary sources and could in groups identify as many different ways of undertaking primary research as possible. Learners could undertake physical examination of example products and explain/ produce a comprehensive list of what information can be gained from a physical handling of a product and its components.	Learners will be able to identify research as primary research or secondary research including advantages and disadvantages, and be able to begin to perform primary research through product inspection.	BBC Bitesize includes a range of types of primary and secondary research and advantages of each.
	2	LO2	Primary research (surveying and questioning users).	Learners could be introduced to a range of information gathering methods that can be used with users e.g. surveys, interview groups. They could analyse the advantages of each method and discuss in which context each might be most suitable. Learners could undertake primary research with a small group of peers, possibly using an example product to comment upon.	Learners will be able to identify a range of ways of collecting the views/ opinions of others through primary research. Learners will be select and undertake methods of primary research objectively.	mymarketreserach has guide to types of research surveymonkey provides advise on writing primary research questions.
	3	LO2	Secondary research.	Learners could be asked to list as many secondary research sources as possible. Learners could be given a product or topic to undertake secondary research on and be required to cite the sources of information identified. They could be asked to draw conclusions based upon their research. Learners could also be advised on checking the validity of sources, possibly supported by examples of poor secondary sources and could be tasked with grading their sources from most to least reliable.	Learners will be able to identify a range of ways of gaining information through secondary research. They will be able to select from and reference sources of secondary information and data objectively.	Go to BBC website and search for 'market research'

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	**4**	**LO2**	Recording research.	Learners could be given outcomes of research (e.g. questionnaire feedback, secondary data) and tasked to use it to draw conclusions. They could be guided in writing up the conclusions and how to evidence and explain the key points they are trying to present.	Learners will be able to record and report research findings in detail. Learners will be able to summarise research appropriately.	
	5	**LO2**	Strengths and weaknesses (material properties).	Learners could be provided with a range of samples of common materials and create a table of their strengths and weaknesses. Learners could draw conclusions based on visual analysis (e.g. aesthetics, texture) and be guided through simple material tests to draw conclusions of physical properties (e.g. strength, durability). Learners could use secondary sources to research in more detail material properties e.g. embodied energy, sustainability.	Learners will be able to describe the strengths and weaknesses of a products based upon material selection for its components. Learners will be able to form conclusions based upon these findings.	Go to www.mr-dt.com search for 'materials' for simple quick reference tables of common materials
	6	**LO2**	Strengths and weaknesses (finish, aesthetics, durability, sustainability, life cycle, energy use, power sources).	Learners could be given opportunity to research the strengths and weaknesses of existing products. Learners could be provided with a list of key points to consider e.g. finish, aesthetics, durability, sustainability, life cycle, energy use, power sources. Learners could be asked to analyse several similar products.	Learners will be able to describe the strengths and weaknesses of a products based upon other considerations, such as: finish, aesthetics, durability, sustainability, life cycle, energy use, power sources. Learners will be able to form conclusions based upon these findings.	Ergonomics4schools provides a comprehensive guide to how aesthetics and ergononmics and other factors can be considered when analysing products.

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Spring Term	**7**	**LO2**	Strengths and weaknesses (suitability for users).	Learners could be provided with a profile of a user and asked to comment on the suitability of a product to meet their needs. Learners could be guided to use primary research e.g. conduct an interview, focus group, anthropometric data. Learners could also be guided how to use secondary resources e.g. online product reviews, review of similar products.	Learners will be able to undertake appropriate research to identify if products are suitable for a target user. Learners will be able to select the most appropriate research methods based upon the nature of the product provided. Learners will be able to draw conclusions from their findings.	
	8	**LO2**	Charts and diagrams.	Learners could be presented with examples of tables to analyse containing qualitative (written) data and quantitative data (numbers). They could produce tables containing written data based upon information obtained from the previous strength and weakness tasks. They could create quantitative data by grading or scoring their findings. Learners could use this data with spreadsheet programs to create and present charts and graphs.	Learners will be able to produce graphs and charts from data. They will be able to identify appropriate methods for arranging and presenting data using graphs, charts or diagrams so it is both clear and meaningful.	Go to Skills You Need and search 'graphs' and 'charts' for a guide to common diagrams and their uses.
	9	**LO2**	Annotated sketching.	Learners could review a selection of annotated sketches to identify good practice. Learners could be asked to analyse an existing product through annotated sketches e.g. simple assembly drawings, sketches showing operation or asked to sketch diagrams to support the strengths and weaknesses identified in previous tasks.	Learners will be able to use annotated sketches or diagrams to assist in describing findings of product research.	Go to YouTube and search for 'sketching and annotation' for information and guides to producing and annotating diagrams.
	10	**LO2**	Researching an existing product.	Learners could practice skills developed in this LO to research and compare a range of similar products. Learners could be asked to produce a recommendation on which product is most suitable and be asked to justify their decision. Learners could share their findings as a presentation.	Learners will be able to summarise source information and data and produce an overall conclusion of the strengths and weaknesses of existing products.	

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	1	LO3	Structured procedures for disassembly - use of manuals and guides.	Learners could theorise reasons for using manuals for disassembly. Example manuals, information provided from manufacturers digitally and video guides could be studied with respect to example products. Learners could practice taking apart simple self-assembly items using the assembly instructions for guidance.	Learners will be able to view and interpret guidance for product disassembly from a range of sources. They will be able to identify pertinent information and explain how they may use it to assist in disassembling a product.	ifixit contains disassembly and repair guides for hundreds of devices. Also has a range of teardown videos of popular products.
	2	LO3	Guidance for recording disassembly.	Learners could be given examples of disassembly notes and tasked to draw conclusions from them. They could be guided in writing up their own disassembly procedure, supported by a checklist of key points to include.	Learners will be able to record and report findings for product disassembly in detail and be able to draw suitable conclusions from it.	
	3	LO3	Safe use of tools – guidance.	Learners could be guided in a practical situation using a range of hand tools typically used in disassembly. Learners could risk assess hand tools and produce guidance notes for correct use and best practice. This could include the use of any personal protective equipment (PPE).	Learners will be able to identify a range of hand tools used for disassembly. They will be able to identify hazards and risks, and safety considerations. Learners will be able to make and justify suitable choices of hand tools for activities.	The HSE website includes comprehensive guides to risk assessment including templates. Go to Worksmart search for 'five steps to a risk assessment'.
	4	LO3	Disassembly procedures.	Learners could be presented with an example product. They could be asked to plan the steps for disassembly of the product and explain the choice of tools they intend to use. Learners could undertake the disassembly and then review and add to their initial plan for disassembly.	Learners will be able to produce a plan to undertake disassembly of a product. They will be able to take into account tool selection, hazards/risks and use of personal protective equipment (PPE).	

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	**5**	**LO3**	Analysing a product: components.	Learners could examine component parts of products, possibly linked to the previous disassembly task. Learners could be tasked with producing a short report on the number and type of components. Learners could be asked to identify any pre-assembled or standard components used and identify the purpose of each component part and how it contributes to the function of the overall product.	Learners will be able to analyse individual component parts of a product. They will be able to analyse the component as an separate object and as part of an assembly.	Go to technologystudent and search for 'standard components'
	6	**LO3**	Analysing a product: assembly method.	Learners could examine an existing product, linked to the previous disassembly task. Learners could be tasked with documenting the method of assembly for the product. Learners could be asked to identify temporary and permanent fixings. Learners could be asked to comment on ease of disassembly or repair due to these factors. Learners could compare similar products and analyse which would be easiest to disassemble or repair.	Learners will be able to analyse the assembly methods used in a product. They will be able to comment on effectiveness and suitability of chosen fixings.	BBC Bitesize has a guide to temporary and permanent joining methods used on most common materials.
	7	**LO3**	Analysing a product: material choice.	Learners could use materials research from LO2 to analyse the material choices made for a given product. Learners could comment on suitability of the material used and produce a report suggesting which properties make it a suitable choice. Learners could analyse several similar products making use of a variety of materials to enable them to compare these.	Learners will be able to analyse an existing product and its composite components through evaluating the material choices made. They will be able to analyse the materials properties and explain their suitability in relation to the function of the product or component.	www-materials.eng.cam.ac.uk/mpsite/DT.html has a guide to many common materials and their properties and well as a range of case studies

	Event	Learning Outcome	Topic area/subtopic Area (from R106 specification)	Suggestions for delivery/activities (including scope and depth)	'Have they got it?' – internal unit links with commentary	Useful external resources
Summer Term	**8**	**LO3**	Analysing a product: production methods and manufacturing processes.	Learners could be asked to identify the possible production method for a product to be disassembled (i.e. one-off, batch or mass production) They could be asked to link a variety of components from a disassembled product with their likely manufacturing processes. Learners could link this to previous tasks on manufacturing processes and produce a report on effect on quality, cost and effectiveness.	Learners will be able to analyse an existing product and composite components through evaluating the manufacturing processes employed. They will be able to explain their suitability in relation to the function of the product or component.	
	9	**LO3**	Analysing a product: maintenance considerations.	Learners could be introduced to common methods of maintenance for products. This could take the form of a hands on practical maintenance task e.g. bikes. Learners could practice simple maintenance tasks e.g. visual inspections for wear, appropriate cleaning or lubrication. Learners could also undertake more complex tasks e.g. tensioning/tuning parts or replacement of component parts.	Learners will be able to analyse an existing product and composite components through maintenance considerations. They will be able to identify what regular maintenance must be undertaken on components, where calibration or optimisation is required and where replacement of parts is possible.	Go to healthworkinglives and search for 'maintenance of equipment' YouTube contains numerous guides on maintaining products including bikes, tools and engines
	10	**LO3**	Disassembling an existing product.	Learners could practice all skills learnt in LO3 through the disassembly of a product. Learners could use the activity to produce a checklist of how to write up a successful disassembly procedure for future use. Learners could share findings of their disassembly with peers analysing similar products and compare their findings.	Learners will be able to successfully analyse a product through disassembly, recording and summarising their findings in detail.	

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