ENGINEERING: OCR- Engineering Design Level 1/Level 2 - J822

Year 10

What are the aims and intentions of this curriculum?

Cambridge National Engineering Design is practical, accessible, fun to teach and exciting to learn, it inspire students to develop real-world skills to prepare them for their future. Additionally, the course develops students so they are able to identify market opportunities and solve problems, which contribute to the development of new products and systems. This qualification is aimed at learners who wish to study the processes involved in designing new engineered products and the requirements of a design specification. Through research and practical activities, learners will understand how market requirements and opportunities inform client briefs.

They will also learn how to communicate ideas using a variety of engineering conventions that include freehand sketching, formal drawing techniques , which include Computer Aided Design and Computer Aided Manufacturing. The Cambridge Nationals in Engineering Design encourages 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. This course prepares students to continue their studies at surrounding colleges at KS5 completing Level 3 qualifications or the opportunity to start apprenticeships in areas such as Engineering, Carpentry and plumbing

Term	Topics	Knowledge and key terms	Skills developed	Assessment
Autumn 1	**R038**: Designing processes; stages and strategies, cyclic approach. **R038**: Sketching and drawing.	Students will study about various key terms for example, Engineering design processes, stages and strategies, types of designs and their applications. The stages involved in design strategies: □ Linear design □ Iterative design □ Inclusive design □ User-centered design □ Sustainable design □ Ergonomic design Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach: □ Analysis of the design brief	Students will be able to: ◆ Identify the context in which each strategy might be applied. ◆ The relative advantages and disadvantages of each strategy. ◆ Relative advantages and disadvantages of primary and secondary research for product requirements. ◆ How the information obtained from each method contributes to the design process. ◆ Generation of design ideas may refer to the creation of the initial design or to the modification/ improvement of the existing design.	Summative and formative assessment. Questioning Research and presentation Peer assessment Teacher assessment Course work grade

		□ Methods of researching the product requirements ♣ types of information obtained from primary research ♣ types of information obtained from secondary research ♣ market research to determine existing products ♣ interviews with potential users and focus groups ♣ use of tables of anthropometric data ♣ analysis of existing products using: ○ ACCESS FM (Aesthetics, Cost, Customer, Environment, Size, Safety, Function, Materials and Manufacturing) ○ Product disassembly	**Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups.** **Online and media** **The impact of viewing harmful content when conducting research.** **Careers in Engineering** Future opportunities By developing applied knowledge and practical skills, this course will help give students the opportunity to progress on to A Levels, a Cambridge Technical in Engineering, an apprenticeship or university. The sky's the limit with Engineering Design. **Graduate opportunities** • **Drafting technician** • **CAD drafter** • **CAD Designer** • **Project Manager/Engineer** • **Manufacturing Engineer** • **Design Engineer** • **Process Engineer** **No matter what you progress on to – the skills you'll learn from a Cambridge National will prepare you for the future.**	
Autumn 2	**R038**: Sketching and drawing, CAD	□ Production of an engineering design specification □ Generation of design ideas by sketching and modelling.	Students will be able to: ◆ Identify and explain the difference between needs and wants.	Summative and formative assessment. Questioning

	R039: Sketching design ideas activity (communicating designs)	Types of criteria included in an engineering design specification: □ Needs and wants □ Quantitative and qualitative criteria □ Reasons for the product criteria included in the design specification (ACCESS FM): ♣ Aesthetics ♣ Cost ♣ Customer ♣ Environment ♣ Size ♣ Safety ♣ Function ♣ Material ♣ Manufacturing Types of drawing used in engineering: ◆ Freehand sketching ◆ Isometric ◆ Oblique ◆ Orthographic drawings ◆ Exploded views ◆ Assembly drawings ◆ Block diagrams ◆ Flowcharts ◆ Circuit diagrams ◆ Wiring diagrams Produce a freehand sketch of a design idea using: □ 2D/3D sketches □ Thick/thin lines □ Texture □ Tone □ Shading □ Annotation and labelling techniques: ♣ explain key features ♣ functions, ♣ dimensions ♣ materials Produce an isometric sketch for a design proposal.	◆ Analyze the difference between quantitative data and qualitative data. ◆ Discuss and explain the typical applications and relative advantages and disadvantages of each drawing technique. ◆ Develop regular solids: cube, rectangular block, hollow object and a cylinder. ◆ Compound shapes Students must be able to produce freehand sketches of a design idea or design proposal using rendering techniques: thick/thin lines; texture; shading and annotation to demonstrate the design. It would be highly unusual to see the same output from students in a cohort. Ensure that students produce a range of design ideas and proposals that respond to the specification provided, using both 2D and 3D techniques and utilise graphical communication methods to enhance their ideas. Encounters with further and higher education. All students will understand the full range of learning opportunities that are available to them. This includes both technical and academic	Research and presentation Peer assessment Teacher assessment Course work grade

			routes and learning in schools, colleges, universities and in the workplace.	
Spring 1	**R038**: Sketching and drawing, CAD **R039**: Drawing design ideas activity.	Using CAD drawing software: ◆ Advantages and limitations of using CAD drawing software compared to manual drawing techniques. Exploring and developing working drawings: □ 2D engineering drawings using third angle orthographic projection. □ Standard conventions ♣ title block ♣ metric units of measurement ♣ scale ♣ tolerance □ Standard conventions for dimensions: ♣ linear measurements ♣ radius ♣ diameter ♣ surface finish □ Meaning of line types: ♣ outlines ♣ hidden detail ♣ Centre line ♣ projection ♣ dimension ♣ leader line □ Abbreviations: ♣ across flats ♣ centre line ♣ diameter ♣ drawing ♣ material ♣ square □ Representations of mechanical features: ♣ threads ♣ holes ♣ chamfers	Students will understand the standard conventions in BS 8888 and how these are applied. Students are required to develop one design proposal further using rendering techniques to present both 2D and 3D sketches. Detailed annotation and labelling should be used to help describe the function, features, material choices, assembly methods etc. Students should explain how their design meets the design specification provided. **R039**: NEA Assessment (working on). (**Practical)** Basic first aid and Health and Prevention Student will understand the basic procedure if they sustain cuts and burns from tools and soldering iron. They will carry out risk assessment and teacher will demonstrate the use of all tools, equipment and machines. Students will also know the procedure to be taken in the event of accidents. All students will be thoroughly assessed and given a certificate before they are allowed to use the machines. Linking curriculum learning to careers.	Summative and formative assessment. Questioning Research and presentation Peer assessment Teacher assessment Course work grade

		♣ countersinks ♣ knurls Produce a 3rd angle orthographic projection drawing of a design proposal using standard conventions. Produce an assembly drawing for a design proposal. □ Isometric projection □ Centre line □ Parts list to include up to 4 parts □ Parts number referencing □ Assembly instructions	Students will understand the different careers paths that effectively use different Technical drawing technique such as isometric and orthographic projections. Students will know that these techniques are very useful for designers – particularly architects, industrial and interior designers and engineers, as they are ideal for visualizing rooms, products, and infrastructure. They will also understand that they are also a great way to quickly test out different design ideas. They also illustrate the 3D nature of an object, without being drawn in 3D software, and measurements can be made to scale along the principal axes.	

Spring 2	**R038**: Sketching and drawing, CAD **R039:** Producing CAD models activity. **R039:** NEA Assessment (working on)	Produce a 3D CAD model of a design proposal to include compound 3D shapes. Produce a 3D CAD model of a design proposal to include compound 3D shapes: □ CAD sketch tool features: ♣ lines ♣ arcs ♣ polygons ♣ extrudes ♣ revolves ♣ sizing ♣ dimensioning ♣ shelling ♣ holes □ CAD reference geometry: ♣ work planes □ CAD rendering Produce 3D CAD assemblies of components: □ Aspects of CAD assembly: ♣ multiple components ♣ mate tools ♣ mate constraint tools ♣ animation	Students must be able to produce a 3rd angle orthographic drawing and an assembly drawing for a design proposal. They must use the correct standards and conventions. Manual production of drawings refers to either the use of drawing boards or 2D CAD software, so access to either drawing boards or drawing instruments, or access to a 2D CAD software, is required. Students should ensure produce a range of engineering drawings following standard conventions (BS 8888). Student should demonstrate their design proposal, students should utilize a range of assembly drawing techniques. **Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design**. **Mental Health and Well being** Engineering has always been characterized by its rigor, emphasis on productivity, resiliency and hard work. Student will be encouraged to come forwards if workload becomes too much to handle. A safe space will be provided for students to talk about their emotions accurately and sensitively using appropriate vocabulary. Curriculum will be tailored so all students are able to access it. Teachers will know how to recognize early signs of mental wellbeing concerns.	Summative and formative assessment. Questioning Research and presentation Peer assessment Teacher assessment Course work grade
Summer 1	**R038**: Influences on engineering product design.	How manufacturing considerations affect design.		

	R039: NEA Assessment (working on).	Scale of manufacture: ♣ one-off ♣ batch ♣ mass □ Material availability and form □ Types of manufacturing processes: ♣ wasting ♣ shaping ♣ forming ♣ joining ♣ finishing ♣ assembly □ Production costs ♣ labour ♣ capital cost Influences on engineering product design. □ Market pull and technology push □ British and International Standards □ Legislation □ Planned obsolescence □ Sustainable design (6Rs) ♣ Rethink ♣ Reuse ♣ Recycle ♣ Repair ♣ Reduce ♣ Refuse □ Design for the circular economy.	Students will be able to: ◆ Explain typical products manufactured at different scales of manufacture. Identify and explain Quality standards such as: ◆ British Standards (BS) ◆ United Kingdom Conformity Assessed (UKCA). ◆ Legislation related to health and safety regulation and risk assessment. Linking curriculum learning to careers. Students will understand that CAD is extremely important and is needed by most of the engineering fields to effectively do their jobs and provide the best possible services to clients. Some fields are highlighted below: • **Architects, Architectural designer, and drafter.** • **Electrical engineer, design and drafter.** • **Electronics engineer, design and drafter.** • **Plumbing designer** • **Interior designer.** • **Industrial engineer.** • **Manufacturing engineer.** • **Mechanical engineer, design and drafter**. • **Structural engineer, designer, and drafter** **What industries use AutoCAD?** • **Aerospace & Aviation** • **Consumer products** • **Manufacturing**	Summative and formative assessment. Questioning Research and presentation Peer assessment Teacher assessment Course work grade

			• **Medical Device** • **Industrial products** • **Oil & Gas** **Civil, Structural**	
Summer 2	**R038**: Make, model and evaluate; virtual and physical prototypes. **R039:** NEA Assessment (submit for moderation)[1]	Make and evaluate: □ The reasons for the use of modelling ♣ to test proportions ♣ to test scale ♣ to test function □ Virtual modelling of the design idea □ Physical modelling of the design idea □ Manufacture or modification of the prototype. ♣ Comparison of the model or prototype against the requirements of the design brief and specification. Produce 3D CAD assemblies of components: □ Aspects of CAD assembly: ♣ multiple components ♣ mate tools ♣ mate constraint tools ♣ animation	Students will be able to develop complex shape which includes dimensions, lines and angles. Students will use their knowledge of 3D CAD software in order to produce a virtual 3D model from the product specification provided. • Different views of the virtual 3D model should be evidenced, and students should be able to simulate the operation of the product. **Build and apply a repertoire of knowledge, understanding and skills in order to design and make high quality prototypes and products for a wide range of users.** **Understand and respectful relationships, including friendships.** The legal rights and responsibilities regarding equality will be reinforced with reference to the protected characteristics as defined in the Equality Act 2010 that everyone is equal and unique. Students must consider that some peers may find it difficult to do their physical modelling and manufacture and modify their prototype. . They will be encouraged to offer help to their peers and not criticize their effort. Students will understand that stereotype based on disability, religion, sexual orientation or race can cause damage when comparing their models and prototypes.	. Summative and formative assessment. Questioning Research and presentation Peer assessment Teacher assessment Course work grade

			Linking curriculum learning to careers. Student will understand the links between what they are studying and different career paths. They will understand the importance of model and prototype in the design and manufacturing process. They will understand that being a prototype engineer is very lucrative as they would be part of a product development team that designs prototypes for new kinds of industrial products. They will understand that prototypes are a key step in the development of a final solution, allowing the designer to test how the solution will work and even show the solution to users for feedback.	