SUBJECT: ENGINEERING: OCR- ENGINEERING DESIGN LEVEL 1 / LEVEL 2 - J822

Year 9

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.

Highlighted in green are links to PSHE in the curriculum
Highlighted in blue are links to Careers in the curriculum

Term	Topics	Knowledge and key terms	Skills developed	Assessment
Autumn 1	**Careers** **Accident and emergency procedures and workplace roles and responsibilities.** ***Objectives:*** Define the terms safety and hazards. To develop the ability to recognize threats to personal safety in a range of contexts and to consider how these may be dealt with. Identify at least 4 types of hazards that may be found in the workplace.	Understand safe and effective working procedures in an engineering workplace. **Key words** **Safety** – the condition of being safe from undergoing or causing hurt, injury, or loss. **Hazard** – a source of danger. **Emergency-** a serious, unexpected, and often dangerous situation requiring immediate action. **Accident-** an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury.	**Careers in Engineering** **Did you make the right choice?** **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 – what about becoming an Aerospace Engineer?** **No matter what you progress on to – the skills you'll learn from a Cambridge National will prepare you for the future.**	Completion and grading of assignment booklet and homework task. Participation in class discussions. Questioning and answering. Grading of presentation using rubric. Peer assessment using rubric. Grading of written activities.

	Discuss the procedures to follow regarding workplace hazards and safety. Understand what a risk assessment is and why they are used. Review other peoples risk assessments. Create our own risk assessments for specific practical task. List at least eight types of emergencies that can occur in a workplace. Explain what to do in at least four kinds of emergencies**.** Identify important information employers should provide about how to respond to workplace emergencies. Explain and evaluate the importance of an Emergency Action Plan (EAP) Explain legal legislation and regulations regarding health and safety in the workplace. Explain the importance of employees and employers adhering to correct legislation, policy and procedures in an engineering workplace.	**Emergency Action Plan** – must be in writing, kept at the workplace, and available for employees to review. The purpose of an EAP is to facilitate and organize what actions should take place among employees and employers during an emergency at work. **Personal safety**- is "an individual's ability to go about their everyday life free from the threat or fear of psychological, emotional or physical harm from others." A **risk assessment** is a systematic method of looking at work activities, considering what could go wrong, and deciding on suitable control measures. **Risk-** a situation involving exposure to danger. **A safety sign**- **'**information or instruction about health and safety at work on a signboard, a colour, an illuminated sign or acoustic signal, a verbal communication or hand signal. **Safety measures**-activities and precautions taken to improve safety. **Occupational and Safety Health Administration** – "OSHA" provides information, trains workers/employers, and assists workers/employers on workplace health and safety conditions. **Occupational Safety and Health Act** – passed in 1970 to govern workplace health and safety in the private sector. **Legislation-** a law or set of laws suggested by a government and made official by a parliament.	***Know how to identify and control hazards in the workplace***. **Within the workplace:** methods to identify hazards e.g. statements, analysis of significant risks, prediction of results or outcomes of those risks, use of accident data, careful consideration of work methods. **Working environment:** consideration of the workplace and its potential for harm e.g. confined spaces, working over water or at heights, electrical hazards, chemicals, noise. **Hazards which become risks**: identification of trivial or significant risk; potential to cause harm; choosing appropriate control measures; electrical safety e.g. identify and control hazards, cause of injury, effects of electricity on the body, circuit overloading; mechanical safety e.g. identify and control hazards, cause of injury, rotating equipment, sharp edges; safety devices e.g. fuses, guards, fail safe, sensors. **Identifying and explaining Legislation and Regulations**: Able to explain the consequences of management not abiding by legislation and regulations and carrying out their roles and responsibilities in a given health and safety situation. ***Be able to carry out a risk assessment and identify control measures***. **Risk assessments:** items/area to be assessed e.g. machine operation, work area; five steps (principal hazards, who is likely to be injured/harmed, evaluate the risks and decide on adequacy of precautions, recording findings, review assessment)	Completion and grading of project.

	Design and make an original safety sign that will be suitable for an Engineering workshop. Select and use appropriate tools, equipment and components in the marking out of their safety signs. Students can construct their safety signs using given materials, tools and equipment.	**Regulations-** a rule or directive made and maintained by an authority. **Employee's Rights** – laws, regulations, policies, and procedures in place to protect employees.	**Use of control measures:** e.g. remove need (design out), use of recognized procedures, substances control, guarding, lifting assessments and manual handling assessments, regular inspection, use of Personal Protective Equipment (PPE), training of personnel, other personal procedures for health, safety and welfare. ***Understand the methods used when reporting and recording accidents and incidents.*** **Principles:** why employers keep records of serious accidents, incidents and emergencies; responsibilities of competent persons; cost of accidents e.g. direct, indirect, human consequences; trends e.g. major causes, fatal and serious injury, methods of classification, statistics. **Recording and reporting procedures:** regulations on accident recording and reporting e.g. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995, accident book, company procedures; procedures to deal with near misses or dangerous occurrences 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.	
Autumn 2	**Preparing for and carrying out an engineering activity.** ***Objectives:*** Recognize the importance of safety when using workshop tools, equipment, machines and components; and Recognize potential hazards in products, activities and environments. Demonstrate an understanding of risk assessment: – what is the potential hazard? – who could be harmed and how? – what can be done to prevent it from happening? Identify the tools and equipment required to produce a reliable, functioning technological product. Design and make an original product from a given scenario to solve an Engineering problem, taking in consideration the design process.	**Learning Aim:** Identify health and safety signs used in the workshop. Identify safe procedures and practice. **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.** **Key words** **Tools-** a device or implement, especially one held in the hand, used to carry out a particular function. **Equipment-** the necessary items for a particular purpose. **Design-** a plan or drawing produced to show the look and function or workings of a building, garment, or other object before it is made. The **Design Process** is an approach for breaking down a large project into manageable chunks. This process can be used to define the steps needed to tackle a project, and remember to hold to all of the ideas and sketches throughout the process.	Complying with essential health and safety requirements. Carry out standard risk assessment on workshop before carrying out practical task. Learners will become expert in using the design process to design and manufacture their own products. They will be able to demonstrate the safe use of all tools needed to manufacture their products. Use different finishing techniques to make final product successful and attracted to customers. **Understand and respectful relationships, including friendships.** **Students will know that some types of behaviour within the workshop and within their relationships can be criminal intent including violent behaviour. Students must be informed that if they use any tools inappropriately, they will be asked to leave the workshop. Students will know that a tool used outside the workshop is classified as a weapon. They will respect each other and endeavor to build positive relationships.** Linking curriculum learning to careers Students will know and understand the different job roles in Engineering design and manufacturing. These includes: • **Drafting Technician** • **CAD Drafter** • **CAD Designer** • **Project Manager/Engineer**	Feedback from class discussion. Grading of worksheets. Questioning and answering. Peer assessment using rubric. Grading of written activities. Completion and grading of project.

			• **Manufacturing Engineer** • **Design Engineer** • **Process Engineer** • **Biomedical Engineering** • **Mechanical Engineering**	
Spring 1	**Introduction to Technical drawing.** ***Objectives*** **At the successful completion of this unit students should:** Have the basic knowledge of Technical Drawing. This knowledge includes the definition, instruments and types of lines commonly used in Technical Drawing. Have the basic knowledge of how to border, set up a Title Block and do the necessary lettering correctly on a drawing paper. Be able to bisect a line correctly and perform other basic operations on lines such as: dividing a line into equal parts and ratios. Develop a comprehensive understanding of the term 'angles'. This includes classifying and constructing angles. Be able to accurately identify types of triangle based upon their classifications. Be able to construct triangles based on different information given, for	**Learning Aim:** To help students to develop a general understanding of the basics of Technical Drawing and its relevance in society. 2. To help students to develop a general understanding of the basic concepts in Technical Drawing and how to apply them in future lessons. 3. Design and make their dream houses or city using the Technical Drawing skills developed in previous lessons. **Generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design**. **Key words** Technical Drawing, tee square, set squares, protractor, French curves, flexi curves, continuous thick and thin lines, chain lines, dimension lines, title block, bordering and guidelines. **Technical drawing**- Technical drawing, also known as drafting or draughting, is the act and discipline of composing plans that visually communicate how something functions or has to be constructed.	Students will develop the art to precision as it is of the utmost importance in all technical drawing. Drafts and product designs in all fields of engineering are expected to be scaled, labeled and arranged exactly as the final product would be. The proper use of the Technical drawing tools and equipment will ensure students master such skills. Students will acquire the skill of Lettering as it is an important part of engineering drawing. It gives information regarding size, and instructions, in the form of notes and dimension. Students will know the importance of the different lines used in Technical drawing as lines represent everything in these drawings. From the depth and intensity of the design that is going to be represented, to the necessary and required details, the section that should be in focus, etc. Everything is represented through the intensity of lines in technical drawings and it is very essential to draw them with all the care and with the required purpose. Students will acquire all the skills required to use Technical drawing instruments to measure and layout drawings, or to improve the consistency and speed of creation of standard drawing elements.	Feedback from class discussion Grading of worksheet on the types of drawing instruments and lines. Grading of research on CAD and Geometry. Marking of students bordered drawing paper. Student feedback from quiz. Marking and grading of students' class work. Assessment of students' input in the demonstrations. Test 1: constructing lines and angles

	example all three sides or 2 sides and one angle.	**Lettering-** Used to give dimensions and other important information needed to fully describe an item. **Guidelines**- Lightly drawn lines used for lettering. **Object Lines**- Thick dark lines that outlines an object **Hidden detail Lines**- Short dash lines use to show non visible surfaces. Usually shows as medium thickness. **Construction line** – very light and thin line use to construct layout work. **Dimension line** – Thin and dark lines use to show the size (span) of an object with a numeric value. **Centre line** – Long and short dash lines. Usually indicates centre of holes, circles and arcs. Line is thin and dark. **Drawing Sheet-** Drawing sheet is a white paper on which an object is drawn which is available in various sizes. **Drawing Board-** Drawing board is generally made of soft wood and it is in rectangular shape. It is used to support drawing sheet, so, the size of board is made according the size of the drawing sheet. **T-Square-** T square is used to draw horizontal and vertical lines on drawing sheet**.** **Compass-** Compass is used to draw an arc or circle with known dimensions on engineering drawing. **Set Squares-** Set squares are used to draw lines with an angle between them. In most of the structures, 30, 45, 60 and 90-degree	Students will acquire the skills needed to construct different angles which will assist them with the trigonometry unit in Mathematics. Linking curriculum learning to careers **Students will understand that Technical Drawing is a very important tool that is used by professionals to perform the following duties:** **Drawing depictions of items, such as buildings, structures and technological machinery.** **Creating blueprints for physical structures, including homes, apartments and office buildings.** **Analyzing preexisting buildings and structures to determine their layout** **Reviewing construction and building plans** **Using technology, software or manual processes to sketch designs.** **Designing interior decoration elements** **Reviewing preexisting construction and design plans and improving upon them if necessary.** **They will also know the different professionals that rely on Technical Drawing skills to successfully complete their daily tasks. These are:** • **Carpenters** • **Drafters** • **Surveyors** • **Engineers** • **Architects** **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	Test 2. Constructing triangles and quadrilaterals.

		lines are most common. So, set squares make the work easier for this type of drawings. **Protractor-**Protractor is used to draw and measure the angles of lines in the drawing. **French Curves-**French curves are made of plastic and they are in irregular shapes. **Perpendicular-** at an angle of 90° to a given line, plane, or surface or to the ground. **"Bisect"** means to divide into two equal parts. You can bisect lines, angles, and more. **Ratio-** the quantitative relation between two amounts showing the number of times one value contains or is contained within the other.	unique. Students must consider that not all their peers will be able to maneuver the drawing tools and should be mindful of that. They will be encouraged to offer help to their peers and not criticize their effort. Teachers will be patient and create opportunity for students to be given one to one support.	
Spring 2	**Technical drawing techniques. (Isometric and Orthographic)** **Objectives:** After this lesson, students will be able to: Explain isometric drawing and its principles. Demonstrate an understanding of how to draw isometrically. Explain the differences between isometric drawing and other three dimensional drawing.	**Learning Aim:** To be able to sample a range of technical drawing techniques. Design and make a tack hammer or bottle opener using skills and knowledge develop in previous lessons. **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.** **Key words**	The students will develop the skills of constructing real life objects in 3D. These are very important skills for engineers because they can easily and unambiguously read off the various dimensions from the drawing and easily communicate between designer, client and manufacturer. Learners will be able to differentiate between 2D and 3D drawings. Learners will be able to explain the differences between isometric drawing and other three dimensional drawing.	Feedback from class discussion. Grading of worksheets. Questioning and answering. Peer assessment using rubric. Grading of written activities. Tests

	Use isometric axis to draw given objects. Explain orthographic projection. Explain the principles of both first and third angle projections. Distinguish between first and third angle projections. Draw objects in first and third angle projections. Learnt how to annotate and dimension a drawing. Learnt how to produce sections and parts drawings. **Project:** **Students will use their knowledge of technical drawing and project development to design and manufacture a model of their dream house or city.**	**Isometric drawing**, method of graphic representation of three-dimensional objects, used by engineers, technical illustrators, and architects. **3D-** three-dimensional. **Oblique drawing:** a projective drawing of which the frontal lines are given in true proportions and relations and all others at suitable angles other than 90 degrees without regard to the rules of linear perspective. **Projections-** A 3D projection or graphical projection maps points in three-dimensions onto a two-dimensional plane. **Orthographic projection**- a method of projection in which an object is depicted using parallel lines to project its outline on to a plane. Third angle projection. First angle projection. **Dimensioning** is the process of specifying part' s information by using of lines, number, symbols and notes.	Learners will be able to draw objects in first and third angle projections and annotate and dimension drawings. **Online and media** **Students will understand the impact of viewing harmful content when conducting research.** Linking curriculum learning to careers. 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. Students will be able to identify the sectors of engineering that intersect to design and develop a city or build a house. These includes: • **Civil engineers** • **Mechanical engineers** • **Plumbers** • **Electrician** • **Land surveyors** • **Structural engineers** • **Environmental engineers**	

			• **Infrastructural Engineers** • **Geotechnical Engineers.** • **Materials engineer.** • **Water resources Engineers** • **Construction Engineers.**	
Summer 1	**CAD –Computer Aided Design.** **The students will be able to:** Open and close a technical program successfully. Navigate software. Identify key areas of the CAD interface. Identify key vocabulary terms related to the CAD program. Perform basic mouse and keyboard functions used with the CAD program. Create orthographic and isometric drawings on different scales. Modify commands: copy, move, paste, offset, fillet. Print a drawing on the classroom printer. **Project:** **Students will use the CAD software to draw an isometric projection of a tack hammer or a bottle opener.** **Students will then use the appropriate tools and equipment**	**Learning Aim:** To be able use CAD to achieve higher levels of accuracy, repeatability and efficiency when producing engineering drawings. Use CAD to design a power supply to precision using both orthographic projection and isometric. To manufacture a power supply using a variety of tools and equipment**.** **Understand and use electrical systems in their products [for example, series circuits incorporating switches, bulbs, buzzers and motors]** **Computer Aided Drawing (CAD):** the use of precision-drawing software programs to accelerate the design process by making it easier to create and modify draft designs. **Plan:** a drawing or diagram, particularly one illustrating the layout and constituent components to design a building, made by projection on a horizontal plane. **Design:** a plan or drawing that demonstrates the form and function of a building, garment, or other object prior to its being created. **Fillet:** a command in CAD software allowing you to create a rounded inside or outside curved corner.	The learner completing these lessons will develop skills and competencies with frequently used commands and terminology related to two-dimensional and three-Dimensional drawing. The students will be able to use computer and CAD software to model different engineering components. Learners will be able to use CAD to design and develop products to be used by consumers. Learners will be able to visualize their final designs of the product that is to be made, it subassemblies and the constituent parts. Learners will use CAD to Improve the quality of their design: With the CAD software students will use large number of tools that will help in carrying out thorough engineering analysis of the proposed 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	Feedback from class discussion. Grading of worksheets. Questioning and answering. Peer assessment using rubric. Grading of written activities. Student feedback from quiz. Marking and grading of students' class work.

	to manufacture a tack hammer or bottle opener.	**Grid**: a pattern of dots or lines within the work area of the software that can be used to aid in drawing. **Offset:** a command that creates a copy of an entity (line, circle, etc.) that is a specified parallel distance away from the current object(s) selected. **Title block:** an area of a drawing sheet that contains information about the actual drawing, including project name, author, scale, drawing number. **Trim:** a command used to "trim" off excess length on an object or entity, to end exactly at the end or intersection of another entity.	recognize early signs of mental wellbeing concerns. 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** • **Medical Device** • **Industrial products** • **Oil & Gas** • **Civil, Structural**	
Summer 2	**TA2 – Design Requirements** Types of criteria included in an engineering design specification. How manufacturing considerations affect design.	**Learning Aims:** To be able use ACCESS FM to analyse an engineering product design specification and product. To be able to explain the advantages and disadvantages of manufacturing techniques	Learners will be able to explain what ACCESS FM Learners will be able to use ACCESS FM to analyse a design brief and create design specifications.	Feedback from class discussions. Grading on worksheets. Questioning and answering.

	TA4 Evaluating Design ideas Methods of evaluating design ideas. Methods of evaluating a design outcome	To be able to qualitative analyse a product against a design brief. **Key words** **ACCESS FM:** a designer's tool used to make you think about products in a critical and analytical way. **Design Brief:** a document for a design project developed by a person or team in consultation with the client/customer. They outline the deliverables and scope of the project including any products or works, timing and budget. **Design Specification:** a detailed document that sets out exactly what a product or a process should present. For example, the design specification could include required dimensions, environmental factors, ergonomic factors, aesthetic factors, maintenance that will be needed, etc. **One Of Production:** involves producing custom work, such as a one-off product for a specific customer or a small batch of work in quantities usually less than those of mass-market products. **Batch production:** products are made as specified groups or amounts, within a time frame. A batch can go through a series of steps in a large manufacturing process to make the final desired product. **Mass Production:** production of substantial amounts of standardized products in a constant flow, including and especially on assembly lines.	Learners will be able to explain the different production techniques, give advantages and disadvantages for each one understand when each one would be used. Learners will be able to give accurate and detailed analysis of products currently on the market and products designed by them.	Peer assessment. Grading of written activities. Marking and grading of students' class work. Marking and grading of end of topic assessment.

		Continuous Production: production method used to manufacture, produce, or process materials without interruption. **Design Analyse:** a decision-making process in which analytical tools derived from basic sciences, mathematics, statistics, and engineering fundamentals are utilized for the purpose of developing a product model that is convertible into an actual product.		