CLEETHORPES ACADEMY HOME LEARNING

Year 10: Engineering

We Are ***CARING*** We Are ***CURIOUS*** We Are ***CREATIVE***

SELF QUIZZING

OUR EXPECTATIONS

- The act of self-quizzing supports retrieval. Retrieval is important because the more we revisit knowledge and ideas, the more likely we are to remember it. The more we remember, the greater sense we can make of our learning.
- You should spend a minimum of *30 minutes a night* focusing on a specific subject's retrieval activity.
- You should bring your completed work to form, every Tuesday, where your work will be checked and additional retrieval activities will be completed to support your retention of the information studied at home.
- Failure to complete the activities each week, will result in further sanctions.

WHAT YOU SHOULD DO

- Each night, select a subject to focus on.
- Read the subject's information really trying hard to remember what you have read. You might want to highlight and add your own notes to the information you have been given.
- Once you are confident that you can recall the information without having to recheck, use the following blank page to write down everything you can remember, using a black or blue pen. Don't worry if you can't remember everything
- In form time, your tutor will ask you to check through your work and use a green pen to "gap fill" any information you may have missed.
- Your tutor will also ask further questions in relation to the information you have read each week, to further support your retention of new knowledge.
- You will be rewarded with carrot points for your efforts each week.

Week 1

Key Terms and Definitions- *Copy the information below.*

Key Term	Definition
Design Brief	A design brief helps clarify the problem a design will solve, the desired outcome, and the constraints of the project. It typically includes information about the project's scope, target audience, objectives, budget, timeline, and specific design requirements.
Specification	Specifications provide a comprehensive description of the product, system, or process, including its components, materials, dimensions, performance criteria, and required functionality. They incorporate relevant industry standards, codes, and regulations to ensure compliance and quality.
Linear Design	Linear design refers to a design process that follows a sequential, step-by-step approach, where each stage is completed before moving on to the next. It's characterized by a one-way flow of communication and a focus on completing each stage in a predetermined order, often without significant iteration or feedback loops.
Morphing	Morphing design refers to the process of transforming one shape or object into another through a series of gradual, intermediate steps.
Mood Board	A mood board is a type of visual presentation or collage consisting of images, text and samples of objects in an arrangement. It can be based on a set topic or theme and can help to convey a general idea or feeling.
Freehand Sketch	A freehand sketch is a drawing which is created manually without the aid of tools like rulers, compasses or stencils. Freehand sketching relies on the designer’s skill without any assistance and includes thick outer lines to frame the shape.
Rendering	Rendering is the inclusion of texture, light, shadow, reflection and any other details which would be seen on the material of an object. The purpose of rendering is to make the design look more realistic.
Prototype	A prototype is an early version of a product which is used to test concepts, scale, features and ideas. It is a physical representation of a design that allows designers to interact, assess the function and then provide feedback to improve upon the initial designs.

Week 2

Questionnaire- Hints and Tips- *Copy the information below.*

1. Define the Purpose and Scope:

- **Clearly state** the objectives of the questionnaire. What specific information are you hoping to gather?
- **Identify** the target audience for the questionnaire. Understanding their background and experience will help tailor the questions appropriately.

2. Develop the Questions:

- **Be Specific:** Avoid vague or ambiguous questions. Ask about one idea at a time.
- **Avoid Bias:** Phrase questions neutrally to prevent leading respondents towards a particular answer. For example, instead of "Do you agree that our product is excellent?", ask "How satisfied are you with our product?".
- **Use Clear Language:** Avoid jargon or technical terms that respondents may not understand.
- **Choose Appropriate Response Formats:** Select the most suitable format for each question, such as:

  Multiple choice: Useful for collecting specific information.

  Likert scales: Great for measuring opinions and attitudes.

  Open-ended questions: Allow for more detailed and nuanced responses.

- **Consider using verbal labels for response options:** This can enhance clarity and reduce bias.
- **Avoid "agree-disagree" scales:** They can introduce unintended bias regardless of opinion.
- **Logical Order:** Arrange questions in a logical sequence, starting with easier, general questions and progressing to more specific or sensitive ones.
- **Visual Appeal:** Ensure the questionnaire is visually appealing and easy to navigate.
- **Use White Space:** Spacing between questions can improve readability.
- **Consider Demographic Questions:** Include these at the end to avoid making respondents feel like they're being interrogated.

4. Pilot Testing:

- **Test with a small group:** Before distributing the questionnaire widely, test it with a few individuals from your target audience.
- **Gather feedback:** Ask for feedback on clarity, length, and any potential issues with the questions or response options.
- **Revise as needed:** Based on the feedback, make necessary revisions to improve the questionnaire.

5. Distribution and Analysis:

- **Choose the right distribution method:** Consider online platforms, email, or paper-based methods, depending on your target audience and resources.
- **Monitor responses:** Track the response rate and identify any patterns or issues with the data.
- **Analyse the data:** Use appropriate statistical methods to analyse the responses and draw meaningful conclusions.

Week 3

The Iterative Design Process- *Copy the information below.*

The iterative design process is a cyclical approach to product development where a design is repeatedly refined and improved through cycles of prototyping, testing, and feedback. It emphasizes continuous learning and adaptation to ensure the final product effectively meets user needs and expectations.

Core Principles:

- **Cyclical Nature:**

  The process involves repeating a series of steps (design, prototype, test, analyse, refine) multiple times.

- **User-Centred:**

  User feedback is crucial for identifying areas of improvement and guiding the refinement process.

- **Incremental Improvement:**

  Each iteration builds upon the previous one, leading to a more refined and effective product over time.

- **Flexibility and Adaptability:**
  Iterative design embraces uncertainty and allows for changes based on new information or insights gained during testing.

Key Steps:

1. **1. Design:**

   The initial design is created, often a prototype or mock-up.

2. **2. Prototype:**

   A basic version of the product is built to allow for testing and evaluation.

3. **3. Test:**

   Users interact with the prototype and provide feedback on its usability, functionality, and overall experience.

4. **4. Analyse:**

   The feedback is analysed to identify areas of strength, weakness, and potential improvements.

5. **5. Refine:**
   Based on the analysis, the design is modified and improved, and the process repeats.

Benefits:

- **Improved User Experience:**

  Iterative design ensures that the final product is well-suited to user needs and preferences.

- **Reduced Risk:**

  By identifying and addressing issues early in the development process, the risk of costly redesigns later on is minimized.

- **Increased Innovation:**

  The flexibility and adaptability of iterative design encourage experimentation and the development of more innovative solutions.

Week 4

Pencil crayon- Hints and Tips- *Copy the information below.*

1. Sharpening and Pressure:

- **Keep your pencils sharp:**

  A sharp point allows for greater precision and helps the pigment fill the paper's tooth effectively.
- **Light pressure is key:**

  Start with light pressure when layering colours, gradually increasing pressure for darker tones and blending.
- **Understand pressure shading:**

  Varying pressure allows for shading and blending, creating smooth transitions between colours.
- **Experiment with sideways shading:**
  Hold the pencil on its side to cover larger areas with a smooth, light base.

2. Layering and Blending:

- **Layer colours gradually:**

  Build up colours with multiple light layers rather than trying to achieve the desired shade in one stroke.
- **Use a blender:**

  A burnishing pencil or colourless blender can be used to push the pigment into the paper, creating a smooth, blended effect.
- **Experiment with colour blending:**

  Practice blending colours on scrap paper to understand how they interact and create new shades.
- **Consider colour direction:**
  Use directional strokes when shading to create texture and form.

3. Paper and Techniques:

- **Understand paper tooth:** The texture of the paper (tooth) affects how the pencil lays down colour. Rougher paper will require more layers and a sharper point.
- **Use masking tape:** Masking tape can create clean borders and sharp edges for your artwork.
- **Try different techniques:** Explore techniques like layering, blending, burnishing, and scumbling to find what works best for you.
- **Don't be afraid to experiment:** Practice on scrap paper to develop your skills and confidence.
- **Focus on the subject:** Choose subjects that interest you and practice drawing them to improve your skills.

Week 5

Engineering Drawings- *Copy the information below.*
Engineering drawings, also known as technical drawings, communicate the design of products, structures, or systems. They can be broadly categorized into several types, including assembly drawings, part drawings, schematic drawings, sectional drawings, and various types of 2D and 3D views.
Types of Engineering Drawings:

Assembly Drawings	Show how different parts of a product fit together. They often include exploded views to illustrate the assembly process.
Part Drawings	Detail the dimensions and specifications of individual components within an assembly.
Schematic Drawings	Represent systems and their components using symbols and lines, commonly used in electrical and fluid power systems.
Sectional Drawings	Illustrate the internal features of an object by showing a cut-through view.
Isometric Drawings	Provide a 3D representation of an object, showing all three dimensions (height, width, and depth) in a single view.
Oblique Drawings	Provide a 3D pictorial representation where one face of the object is shown as a flat, two-dimensional view, while the other faces are drawn at an angle, typically 45 degrees, but sometimes at other angles.
Orthographic Drawings	Use multiple 2D views (e.g., front, top, side) to represent an object.
Detail Drawings	Focus on specific parts or features of a design, providing precise dimensions and information.
Site Plans	Show the layout of a building or structure on a piece of land.
Floor Plans	Illustrate the arrangement of rooms and walls within a building.
Elevation Drawings	Show the vertical aspects of a building or structure.
Piping and Instrumentation Diagrams (P&ID)	Used in process industries to represent piping systems and the instruments used to control them.
CAD Drawings	Created using computer-aided design (CAD) software, allowing for precise and efficient design and documentation.
Exploded Views	Show how parts of an assembly fit together by separating them along an axis.
Auxiliary Views	Provide additional views of an object that are not parallel to the principal views (front, top, side).
Cut-out Views	Similar to section views, but may not show the entire cut plane.

Week 6

CAD- Use in industry- *Copy the information below.*

CAD, or Computer-Aided Design, is a crucial tool across numerous industries, enabling the creation, modification, and optimization of designs for products, structures, and systems. It facilitates the transition from concept to production by providing digital representations of physical objects, allowing for detailed analysis, simulation, and collaboration.

Key Industries Utilizing CAD:

- **Manufacturing:**

  CAD is fundamental in manufacturing for designing products, creating 2D and 3D models, and optimizing production processes.

- **Architecture & Construction:**

  Architects and engineers use CAD to visualize and design buildings, infrastructure, and other structures, and to manage construction projects.

- **Engineering:**

  CAD is used across various engineering disciplines (mechanical, civil, aerospace, etc.) to design and analyse components, systems, and structures.

- **Automotive & Aerospace:**

  CAD plays a vital role in designing vehicles, aircraft, and related components, ensuring precision and functionality.

- **Medical Devices & Healthcare:**

  CAD is used in the creation and customization of medical devices, prosthetics, and even in surgical planning.

- **Fashion & Graphic Design:**

  CAD helps designers create intricate patterns, visualize designs, and manage production workflows.

- **Animation & Visual Effects:**
  CAD is used in film and animation for creating storyboards, 3D models, and visual effects.

Benefits of CAD in Industry:

- **Enhanced Precision and Accuracy:**

  CAD allows for the creation of highly detailed and accurate models, reducing errors and improving product quality.

- **Improved Collaboration:**

  CAD systems facilitate easy sharing and collaboration on designs, allowing teams to work together more efficiently.

- **Faster Iteration and Design Optimization:**

  CAD software enables quick design modifications and iterations, leading to faster product development cycles.

- **Reduced Costs and Waste:**

  By enabling virtual testing and simulation, CAD helps identify and address potential issues early on, minimizing costly errors and material waste.

- **Streamlined Production:**
  CAD data can be directly used for manufacturing processes, reducing the need for manual intervention and speeding up production.

Week 7

Graphic Markers (Alcohol Markers)- *Copy the information below.*

Graphic markers are used in engineering design, particularly for sketching, creating technical drawings, and conveying design concepts. They are used alongside other tools like pencils, pens, and technical pens to develop ideas, refine designs, and communicate them effectively to others.

Hints and Tips

- **Paper Choice:**

  Choose for smooth, heavyweight paper (like cardstock) to prevent feathering and bleeding, and to protect the marker nibs, according to Riley Street Art Supply.

- **Light Touch:**

  Avoid pressing too hard, as it can damage the nibs and cause excessive ink flow.

- **Blending:**

  Alcohol markers blend best when the ink is still wet. Work quickly, layer colours from light to dark, and consider using a colourless blender to soften edges and fix mistakes.

- **Storage:**

  Store markers horizontally to prevent ink from pooling in one end and to ensure even ink distribution.

- **Ventilation:**

  Work in a well-ventilated area as the alcohol ink can have a strong smell.

- **Colouring Technique:**

  For larger areas, try using small circular motions to saturate the nib and achieve a smooth finish.

- **Testing Colours:**

  Before applying ink to your artwork, test each colour on a separate piece of paper to see how it looks and how it blends.

- **Blending Techniques:**

  Explore different techniques like layering, using a blender, and rewetting with lighter colours to achieve various blending effects.

- **Fixing Mistakes:**

  A colourless blender can be used to lift colour and correct mistakes, but it's best to work wet-on-wet for the most effective blending.

- **Don't Press Too Hard:**
  Gentle strokes are better than heavy pressure to preserve the marker nibs and paper.

Week 8

Engineering Design Principles and Methodology- *Copy the information below.*

Engineering design and development is the backbone of modern product creation. It combines science, maths and problem-solving to come up with new solutions to real-world problems. This article looks at the basic principles, the latest methods, and the changing practices in engineering design that are going to shape tomorrow's products.

What is Engineering Design & Development?

Engineering design is a systematic process. It transforms ideas into functional products through the application of scientific knowledge, engineering expertise, and creative problem-solving. It encompasses multiple phases: problem identification, research, concept generation, detailed design, prototyping, and optimisation.

The focus of engineering development is on translating design concepts into manufacturable products that meet specifications and satisfy user needs.

Design for Functionality

The primary objective of engineering design is to create products that perform their intended functions effectively and efficiently. This requires a thorough analysis of user requirements and project constraints to develop solutions that address specific needs. Engineers must balance various technical parameters while ensuring optimal performance.

Example: Smart Home Systems

Modern smart home systems are a prime example of designing for functionality, integrating multiple technologies (sensors, connectivity, AI algorithms) to provide seamless automation, energy management, and enhanced security. Engineers must balance processing requirements, battery life, wireless range, and user interface simplicity to create systems that deliver comprehensive functionality while remaining intuitive for users.

Design for Safety

Safety considerations must permeate every aspect of engineering design. This involves identifying potential hazards and implementing measures to mitigate risks to users, operators and the environment. Rigorous safety assessments and adherence to evolving safety standards and regulations are non-negotiable.

Example: Electric Vehicle Safety Systems

In the electric vehicle industry, engineering design prioritises passenger safety through multiple integrated systems. Modern EVs incorporate reinforced battery enclosures, thermal management systems, advanced driver assistance features, and sophisticated crash structures—all designed through comprehensive safety simulation and physical testing protocols.

Engineering Design Principles & Methodology - Cambridge DT (cambridge-dt.com)

Week 9

Labelling and Annotation- *Copy the information below.*

Labels:

- **Purpose:** To identify and categorize elements in a design.
- **Characteristics:** Typically short, concise, and correct terminology.
- **Usage:** Used for selection, grouping, and quick identification of components or features.

Annotations:

- **Purpose:**

  To provide detailed information and context about specific elements in a design.
- **Characteristics:**

  Can include text, symbols, and other graphical elements to clarify design requirements.
- **Example:**

  Dimensions, tolerances, material specifications, manufacturing instructions, links to the specification.
- **Usage:**
  Used to communicate design intent to those involved in manufacturing, construction, or assembly.

Hints and Tips:

- **Define the purpose:**

  Clearly outline the goals of the annotation process and what insights you aim to gain.
- **Develop clear guidelines:**

  Establish comprehensive, easy-to-understand instructions and accurate language.
- **Stay up-to-date:**
  Regularly review and refine annotation guidelines and processes based on feedback and evolving needs.
- **For text:**

  Summarize key concepts, highlight important sections, and make connections between different parts of the text.
- **For images:**

  Label objects, identify features, and provide context to help machine learning models understand visual data.
- **For data visualizations:**

  Highlight key insights and make sure annotations are concise and easy to understand.
- **For creative work:**
  Annotate your process, explain your ideas, and reflect on your work to show development and learning

Week 10

Isometric Drawing- *Copy the information below.*
An isometric drawing is a 2D representation of a 3D object where all three axes (length, width, and height) are equally foreshortened, and parallel lines remain parallel. This results in a simple and clear depiction of the object without distortion. It's commonly used in technical drawings, architectural illustrations, and engineering diagrams.
Key Characteristics:

- **Equal Foreshortening:**

  All three axes are equally foreshortened, meaning they appear to be the same length, even though in reality they are not.

- **Parallel Lines:**

  Parallel lines in the object remain parallel in the drawing, unlike perspective drawings where they converge at a vanishing point.

- **30-Degree Angles:**

  Horizontal lines are typically drawn at 30-degree angles to the horizontal, while vertical lines remain vertical.

- **No Distortion:**
  Isometric drawings offer a clear and undistorted view of the object, making them useful for accurate representation.

How it Works:

1. Start with a Vertical Line:

Establish a vertical line as a reference.

2. Draw Lines at 30-Degree Angles:

Draw lines extending from the vertical line at 30-degree angles to represent the length and width of the object.

3. Maintain Parallelism:

Ensure that all parallel lines in the object remain parallel in the drawing.

4. Complete the Shape:
Connect the lines to form the desired shape, remembering to maintain the 30-degree angles and parallelism.

Uses:

- **Technical Drawings:** Isometric drawings are used to show the dimensions and relationships of parts in a 3D object.
- **Architectural Illustrations:** They are helpful for visualizing buildings and spaces in a 3D manner.
- **Engineering Diagrams:** Isometric projections are used to represent components and systems in engineering designs.

Week 11

Orthographic Drawing- *Copy the information below.*

An orthographic drawing, also known as a working drawing, is a method of representing a three-dimensional object using multiple two-dimensional views. These views, typically including a plan (top), front, and side elevation, are arranged in a standard layout to provide a comprehensive representation of the object's shape and dimensions.

Key features:

- **Multiple Views:**

  Orthographic drawings use at least three views: a plan view (looking down from the top), a front view, and a side view.

- **Standard Layout:**

  The arrangement of these views follows specific conventions, with the plan view often above the side view in third-angle projection, or below it in first-angle projection.

- **Accurate Representation:**

  The views are projected from the object, ensuring that dimensions and shapes are accurately represented.

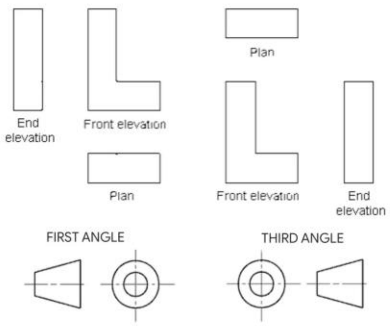
- **Hidden Detail:**
  Hidden lines (dashed lines) are used to show features that are not visible from the chosen view.

Types:

- **First-angle projection:**

  In this system, the object is imagined to be in the first quadrant of a coordinate system. The plan view is positioned below the front view, and the side view is positioned to the left of the front view.

- **Third-angle projection:**
  In this system, the object is imagined to be in the third quadrant. The plan view is positioned above the front view, and the side view is positioned to the right of the front view.



Uses of orthographic drawings:

- **Technical Communication:**

  They are used to communicate the design of an object to manufacturers, engineers, and others involved in production.

- **Construction:**

  They are essential for building and assembling structures, furniture, and other complex products.

- **Detailed Understanding:**
  They allow for a clear understanding of the object's shape, dimensions, and how different parts connect.

Week 12

Exploded View Drawing- *Copy the information below.*

Exploded view drawings in engineering are 3D diagrams that show the individual components of an assembly separated from each other but still arranged in their original relative positions. This helps illustrate how the parts fit together and is particularly useful for assembly and maintenance instructions.

1. Understand the Assembly:

- Begin by thoroughly understanding how the product is assembled. Identify the different parts and their order of assembly.
- Consider how the parts connect and how they need to be separated for clarity.

2. Sketch the Assembly:

- Start with a basic sketch of the assembled product. Use light pencil pressure for guidelines.
- This sketch can be an isometric view or another appropriate projection.

3. Separate the Components:

- Carefully separate the parts along an axis, creating space between them.
- Consider using dotted lines or arrows to indicate the direction and path of movement for each component.

4. Add Details and Labels:

- Refine the individual parts with more detail as needed.
- Add dimensions and labels to clearly identify each component.
- Use leader lines to point to specific features or dimensions.
- Consider using different line weights to differentiate between visible and hidden lines.

5. Final Touches:

- Ensure all parts are clearly visible and their relationships are easy to understand.
- Make sure the exploded view is combined with at least one view of the assembled product.
- Review the drawing for accuracy and clarity.

Key Considerations:

- **Clarity:**

  The primary goal is to clearly show how the product is assembled.
- **Order of Assembly:**

  The exploded view should generally show the parts in the order they are assembled.
- **Accuracy:**

  Ensure that all parts are drawn to scale and that their relationships are accurate.
- **Context:**

  Exploded views are often used in conjunction with other technical drawings and assembly instructions.