Unit 4 PRODUCT DESIGN AND DEVELOPMENT

Q.1) What is Ergonomics in design? Explain types of Ergonomics with example.

- It is the process of designing or arranging workplace product and system so that they fit the people who use them.
- It is referred as branch of science that aim to learn about human ability and limitation, and then apply this to improve people's interaction with product system and environment.
- Ergonomics aims to improve workspace and environment to minimize risk of injury or harm.
- Benefits of ergonomics:
  - Product safety is imperative in today's health and safety driven world.
  - Product that you interact with physically must be comfortable.
  - The product which you use should be easy to be used.
  - Ergonomics design can help make up product enjoyable, Means that customer satisfaction is on high level.

Types of ergonomics:

- Physical ergonomics:
  - It looks at how product design affect our body in a physical way, in particular, how we interact with the product.
  - Means that what Marshall we have to use, what pressure we have to apply, and what movement we have to use.
  - Example of physical ergonomics consideration includes: material handling, physical posture, workspace layout.

- Psychological ergonomics:
  - This is the study of human mental poses, memory reasoning, emotion and perception.
  - This type of ergonomics can apply to any type of product, whatever we use it has an impact on our mind.
  - Examples: decision making, pleasure, stress, cultural and religious difference.
- Organizational ergonomics:
  - Workplace and organization structure of a business.
  - This type of ergonomics generally not apply to product design.
  - Mainly involved in staff management quality, workplace culture and human resource management.

Q.2) Explain BOM with example.

- Bill of material consists of list of various component. This component together create a product example computer.
- Wake no computer is a combination of keyboard, mouse monitor, etc,
- Bill of material is the list of assemblies, sub components, parts and their quantity of each needed to manufacture and product or final product.
- Bilock material can also be treated as list of item required to create a final product.

- Stepwise procedure to prepare bill of materials:
  - Realize what we are going to build.
  - Prepare a list of component in your assembly.
  - Label component of part number to each of the item in the assembly.
  - Each label component should be with some specifications.
  - Label the item number.
  - Prepare. Exact list of quantity required of each of item on bills of material.
  - Arrange multiple level in bills of material.
  - We should use proper reference to prepare bills of material.
  - Bill of material must be proper documentation of Assembly.
  - There should be proper arrangement in bill of material to facilitate various documents related to assembly to make them available to viewers.

Q.3) Define Limit, Tolerance and Fit.

- Limit
  - Definition: The maximum or minimum size that a part can have.
  - Formula: Upper Limit (UL) and Lower Limit (LL)
  - Example: For a shaft with a nominal diameter of 10 mm, the limits might be:
    - Upper Limit (UL): 10.1 mm
    - Lower Limit (LL): 9.9 mm

- Tolerance
  - Definition: The amount of variation allowed in a part's size.
  - Formula: Tolerance = Upper Limit (UL) - Lower Limit (LL)
  - Example: Using the same shaft example:
    - Tolerance = 10.1 mm (UL) - 9.9 mm (LL) = 0.2 mm

- Fit
  - Definition: The relationship between two parts that work together.
  - Formula: Fit = Shaft Size - Hole Size
  - Example: For a shaft with a diameter of 10 mm and a hole with a diameter of 10.1 mm:
    - Fit = 10 mm (shaft) - 10.1 mm (hole) = -0.1 mm (loose fit)

Q.4) What is product architecture? Explain types of product architecture

- Product architecture refers to the overall structure and organization of a product's components, systems, and interfaces.
- It's like the blueprint or framework that defines how the product's various parts work together to deliver its functionality.
- Types of Product Architecture
  - Modular Architecture:
    - Characterized by independent modules or components that can be easily added, removed, or replaced.
    - Each module has a specific function and can be developed, tested, and maintained separately.

- Examples: LEGO toys, computers, smartphones.

- Integral Architecture
    - Characterized by a tightly integrated design where components are highly interdependent.
    - Components are often customized to work together seamlessly.
    - Examples: High-performance sports cars, aircraft, medical devices.
- Open Architecture
    - Characterized by a design that allows for easy customization, modification, and upgrading.
    - Components and interfaces are standardized, making it easy for third-party developers to create compatible products.
    - Examples: Personal computers, Android smartphones, LEGO Mindstorms.
- Closed Architecture
    - Characterized by a proprietary design that is not easily customizable or modifiable.
    - Components and interfaces are often proprietary, making it difficult for third-party developers to create compatible products.
    - Examples: Apple iPhones, gaming consoles, some medical devices.

Q,5) What is the need for engineering drawing? Classify engineering drawing

- Need of engineering drawing:
    - Engineering drawing are essential for effective communication and precise representation of engineering designs.
    - They provide a common language for engineers, manufacturers and contractors to understand and execute complex projects.
- Classification of engineering drawings:
    - Based on purpose:
        - ✓ Detailed drawing: It used to show individual parts or components.
        - ✓ Assembly drawing: it used to show multiple parts fit together.
        - ✓ Installation drawing: it used to show equipment or system are installed.
    - Based on view:
        - ✓ Orthogonal projection.
        - ✓ Isometric projection.
        - ✓ Perspective projection.
    - Based on scale:
        - ✓ Full size drawing: actual size of object.
        - ✓ Reduce scale drawing: smaller than actual size.
        - ✓ Enlarged scale drawing: larger than actual size.
    - Based on application:

- ✓ Mechanical drawings.
- ✓ Electrical drawings.
- ✓ Architectural drawings.
- ✓ Civil drawings

Q.6) What is Fit? Describe the types of Fits

- Definition: The relationship between two parts that work together.
- Formula: Fit = Shaft Size - Hole Size
- Example: For a shaft with a diameter of 10 mm and a hole with a diameter of 10.1 mm:
- Fit = 10 mm (shaft) - 10.1 mm (hole) = -0.1 mm (loose fit)

- Types of Fits:
  - ➢ Clearance fit: clearance always result when meeting part are assembled.
  - ➢ Interference fit: any interference always result when meeting part are assembled.
  - ➢ Transition fit: Either of clearance or interference may always result when meeting parts are assembled.

Q.7) What are the basic principles of dimensioning?

- Dimension should be clear and easy to read. Avoiding confusion.
- All necessary dimension should be included to ensure that part or assembly can be accurately manufactured.
- Dimension should be consistent throughout the drawing using same units and notation.
- Dimensions should be accessible and visible, avoiding overlap with other drawings element
- Dimension should follow established standard and conviction, such as Asme or Iso standards.
- Dimension should be accurate and precise.
- Dimension should be relevant to the specific part or assembly being designed.
- Dimension should be updated and revised as necessary, reflecting changes to the design or manufacturing processes.

Q.8) Define Tolerance? describe the types of Tolerances.

- Definition: The amount of variation allowed in a part's size.
- Formula: Tolerance = Upper Limit (UL) - Lower Limit (LL)
- Example: Using the same shaft example:
  - ➢ Tolerance = 10.1 mm (UL) - 9.9 mm (LL) = 0.2 mm
- Types of Tolerances
  - ➢ Geometric Tolerance: described the acceptable limit for the shape, size and orientation of a part.
  - ➢ Dimensional tolerance specifies the acceptable limit for size of a part.
  - ➢ Linear tolerance: refer to acceptable limit for size of a linear feature such as hole or shaft.

- Angular tolerance: specifies the acceptable limit for the angle between two features.
- Sizes tolerance: specifies the acceptable limit for the size of a part or feature.
- Position tolerance: describe the acceptable limit for position of a feature or part.
- Profile tolerance: specifies the acceptable limit for profile or shape of a feature or a part.

Q.9) What is product modularity? Explain types of modularity.

- Product modularity refers to the degree to which a product is designed to be composed of smaller, independent modules or components.
- These modules can be easily added, removed, or replaced, allowing for greater flexibility, customization, and upgradability
- Types of Modularity:
  - Component Modularity: Breaking down a product into smaller, independent components that can be easily replaced or upgraded.
  - Functional Modularity: Organizing a product's functionality into separate, independent modules that can be easily added or removed.
  - Geometric Modularity: Designing a product's physical structure to be composed of smaller, independent modules that can be easily assembled or disassembled.
  - Process Modularity: Breaking down a manufacturing process into smaller, independent modules that can be easily managed and optimized
  - Service Modularity: Offering customers modular services that can be easily added or removed, such as software updates or maintenance services.

Q.10) What is dimensioning? Describe the arrangement of dimensioning.

- Dimensioning is the process of adding dimensions to a technical drawing or design to provide accurate measurements and specifications for manufacturing, assembly, or construction.
- Arrangement of Dimensioning:
  - Dimension Lines: Dimension lines are placed outside the outline of the object, preferably between the object and the border of the drawing sheet.
  - Dimension Text: Dimension text is placed above or alongside the dimension line, clearly indicating the measurement value.
  - Leader Lines: Leader lines are used to connect the dimension text to the relevant feature or point on the object.
  - Baseline Dimensions: Baseline dimensions are used to dimension multiple features from a common reference point, such as a baseline.

- Chain Dimensions: Chain dimensions are used to dimension a series of connected features, such as the length of a wall or the distance between multiple holes.

- Coordinate Dimensions: Coordinate dimensions are used to locate features or points on an object using x, y, and z coordinates.

- Angular Dimensions: Angular dimensions are used to specify angles between features or surfaces.

- Geometric Dimensions: Geometric dimensions are used to specify the shape, size, and orientation of features or surfaces.