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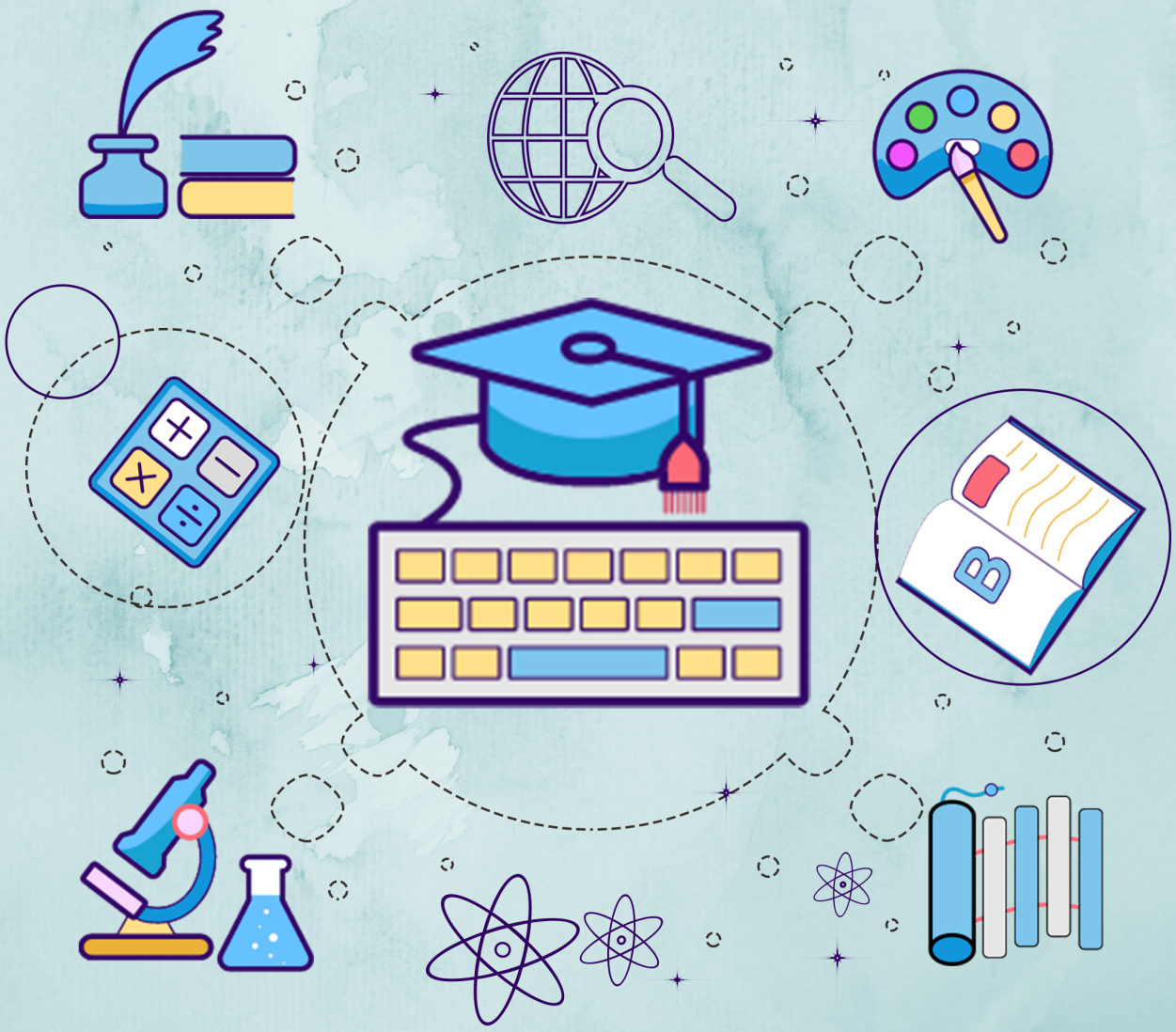

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KTU S4 CSE NOTES

DESIGN AND ENGINEERING (EST 200)

Module 4

Sample Question Paper Solved

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Module 4: Design & Engineering

Background

Problem-based learning

- It empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem,'
- It is a teaching pedagogy that is student- centered
- Students learn about a topic through the solving of problems and generally work in groups to solve the problem where, often, there is no one correct answer.
- Problem-based learning typically follow prescribed steps:
    1. Presentation of an "ill-structured" (open-ended, "messy") problem
    2. Problem definition or formulation (the problem statement)
    3. Generation of a "knowledge inventory" (a list of "what we know about the problem" and "what we need to know")
    4. Generation of possible solutions
    5. Formulation of learning issues for self-directed and coached learning
    6. Sharing of findings and solutions

Project-based learning

- Project-based learning is an instructional approach where we learn by investigating a complex question, problem or challenge.
- It promotes active learning, engages students, and allows for higher order thinking
- Students explore real-world problems and find answers through the completion of a project.
- Students also have some control over the project they will be working on, how the project will finish, as well as the end product.
- Involves
    - Knowledge
    - Critical thinking
    - Collaboration
    - communication

Similarities
Both PBLs: • Focus on an open-ended question or task • Provide authentic applications of content and skills • Build 21st century success skills • Emphasize student independence and inquiry • Are longer and more multifaceted than traditional lessons or assignments

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Differences	
Project Based Learning	**Problem Based Learning**
Often multi-subject	More often single-subject, but can be multi-subject
May be lengthy (weeks or months)	Tend to be shorter, but can be lengthy
Follows general, variously-named steps	Classically follows specific, traditionally prescribed steps
Includes the creation of a product or performance	The "product" may be tangible OR a proposed solution, expressed in writing or in a presentation
May use scenarios but often involves real-world, fully authentic tasks and settings	Often uses case studies or fictitious scenarios as "ill-structured problems"

Modular design

- Module' means separate elements
- Modular design is an approach in which a product is designed for assembling in module-wise fashion.
- Modular products are the artifacts that are composed of many modules
- These modules function together to get the overall function of the product.
- Modular products can be machines, assemblies and components that fulfill various overall functions through the combination of distinct building blocks or modules.
- In a modular product (or modular system), the overall function performed by the product is the results achieved through a combination of discrete units (modules).

Life Cycle Design

- As a design approach, Life Cycle Design is characterized by three main aspects:
    - the perspective broadened to include the entire life cycle;
    - the assumption that the most effective interventions are those made in the first phases of design;
    - the simultaneity of the operations of analysis and synthesis on the various aspects of the design problem.
- Main phases of a product's life cycle
    - Recognition and design development
    - Pre-production
    - Production
    - Distribution

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- Use
- Retirement,

Ergonomics in design

- Ergonomics is basically the science of analysing work and then designing items (tools, equipment, products) and methods to most appropriately fit the capabilities of the user.
- Ergonomics design approach focuses on human comfort and decreased fatigue through product design.
- Means, during the design phase of a product, all the aspects of the product that can cause discomfort while using that product are identified. Then, analyses the causes of the discomfort and appropriate solutions will be incorporated in the product design
- To develop an ergonomic design (for a product or system), the designer will have to consider and analyse anthropometric data (dimensions of human body), posture of working while using the product, kind of movements and kind of workspace.
- ultimately, ergonomic design involves every aspect of user-product interaction, for the comfortable utilization of a product.

AESTHETICS IN DESIGN

- Aesthetics is the feel that a human being perceives.
- When a person perceives a sense of pleasure through any of the senses while using a product, then we can say that the product is aesthetically appealing.
- Example: a beautiful person, a good food, nice perfume
- Products are intentionally designed to generate a defined perception in potential customers
- Aesthetics of a product (that is how a customer feels about a product) is a very important aspect for its business merit and acceptability.
- This feel (or perception) enables the customer to distinguish and choose a product from similar products.
- Few examples for demarcation of percept ions are; hot and cold, smooth and rough, soft and hard, heavy and light, dark and bright, sweet and sour, loud and quiet, sharp and dull, spacious and congested, etc.. customers generally combine few of these feels (or attributes) and arrive at conclusion of a product as reliable, enjoyable and precise.

Bio-mimicry in design

- "**Biomimicry** borrows nature's blueprints, recipes, processes, and ecosystem strategies and then comes up with **design** principles to solve our own problems

Value of engineering (VE)

- Technique for improving the value of the product, project and process
- The term value defined as the ratio of function to cost
- $\text{Value} = \frac{function}{cost}$

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Reverse engineering

- Reverse Engineering is an approach in which an existing product is analyzed and another product is developed in light of the analysis.
- The product that is analyzed can be own product of the producer or a product from a competitor.
- In reverse engineering, a product is dissected or dis-assembled to find out in detail how a part works an why is it used. This information obtained by this process can then be applied to solve own design problem or develop a new product.
- Reverse Engineering is essentially a functional decomposition process in the reverse direction.
- an existing product is analyzed into subsystems, which are further analyzed into deep to ultimately establish the product concept
- This analysis will help the designer to identify weak side of the design

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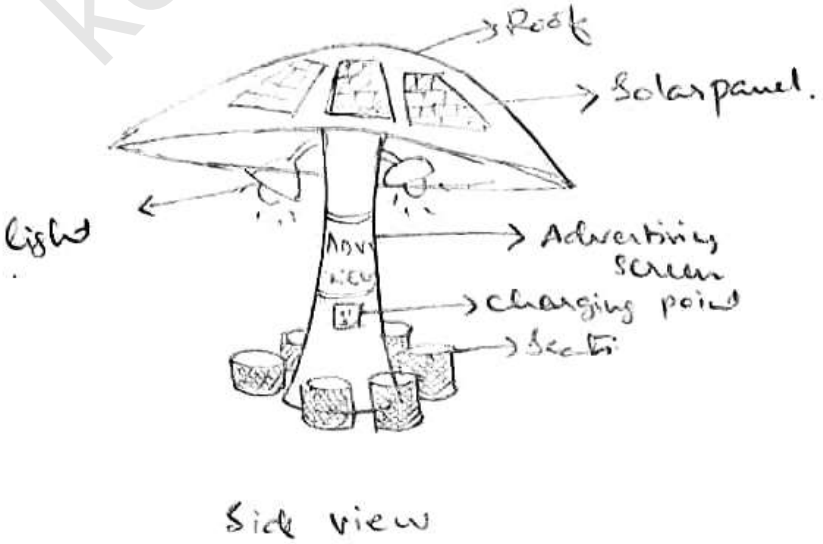
(17) Show the development of a nature inspired design for a solar powered bus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

Solution

- Nature inspired bus waiting shed can be of many options. Some of the options are a banana leaf, or any large leaf, a big mushroom
- Let us discuss the design of the bus station from one of the item, mushroom

- We are using the above shape because it covers a large area and there is space underneath without affecting the rain
- It has a large surface area for placing the solar panel when has sun exposure
- Also its body or middle section can hold the circuit and the battery for the solar panel



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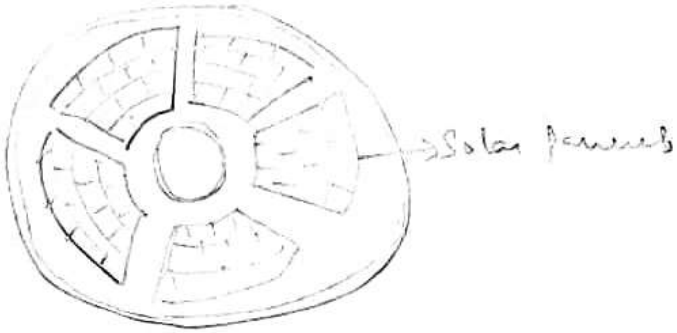
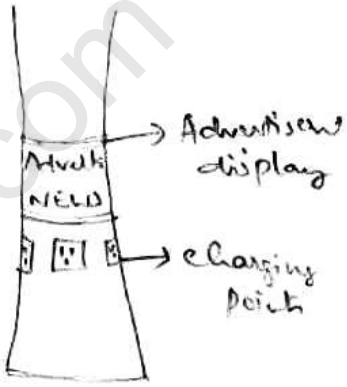


Top view

inner part



- The solar panels can be placed over the top of the design
- The circuits and the batteries can be place at the middle and root parts of the structure
- We can add a LED screen in the surface of the body for the advertisement and the news
- The power supply for the LED screen can be taken from the batteries of the solar panel
- We can add charging points around the body for mobile charging. Which's power can also be drawn from the same battery
- The light for the bus station can also be powered with the same battery
- We can place some permanent seats around the inner body of the structure. Can also have space under the seat for extra batteries

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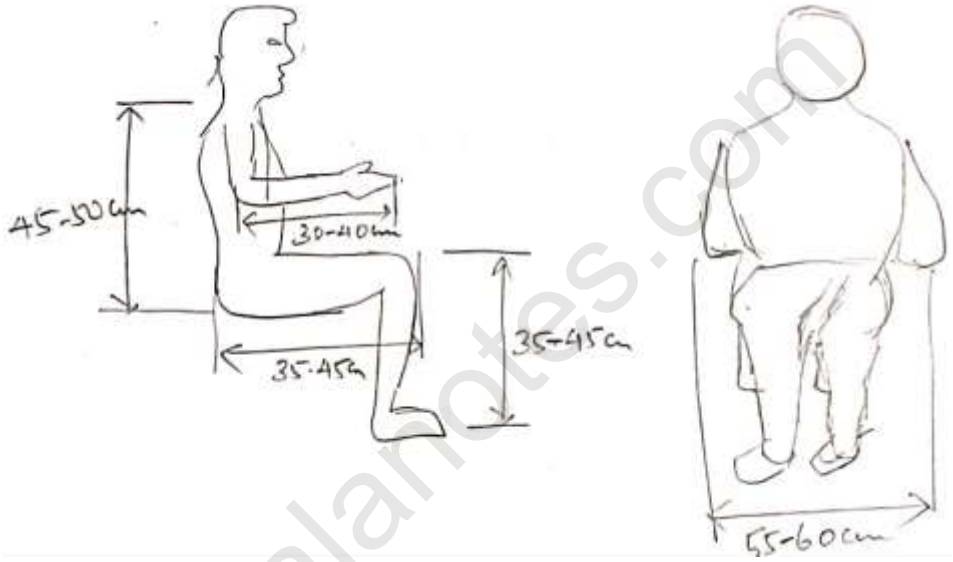
Q2) Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

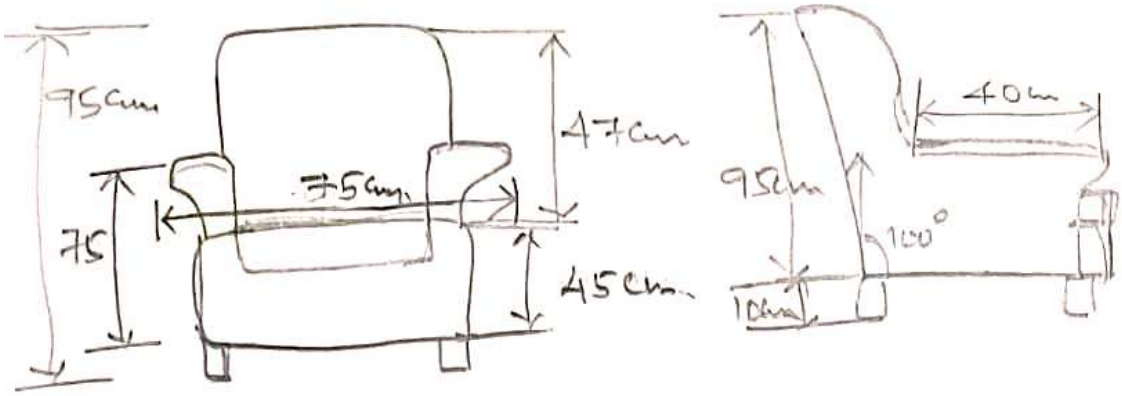
Solution:

Ergonomic design

- In the ergonomic design we have to focus on the human comfort and decrease fatigue through product
- A sofa is a device used for comfort sitting or lying if needed
- The measurement of an average human being is as shown in figure



- A sofa can be used by any age range of people so that the height of sitting section of the sofa can be 45 cm
- The height of the back side must be 47 cm
- The total width of the sofa chair must be 75 cm
- The hand rest area must be of height 75 cm
- The total height of the sofa is nearly around 95cm
- For comfort sitting the sofa's backside angle is slightly gave n angle of 100 degree



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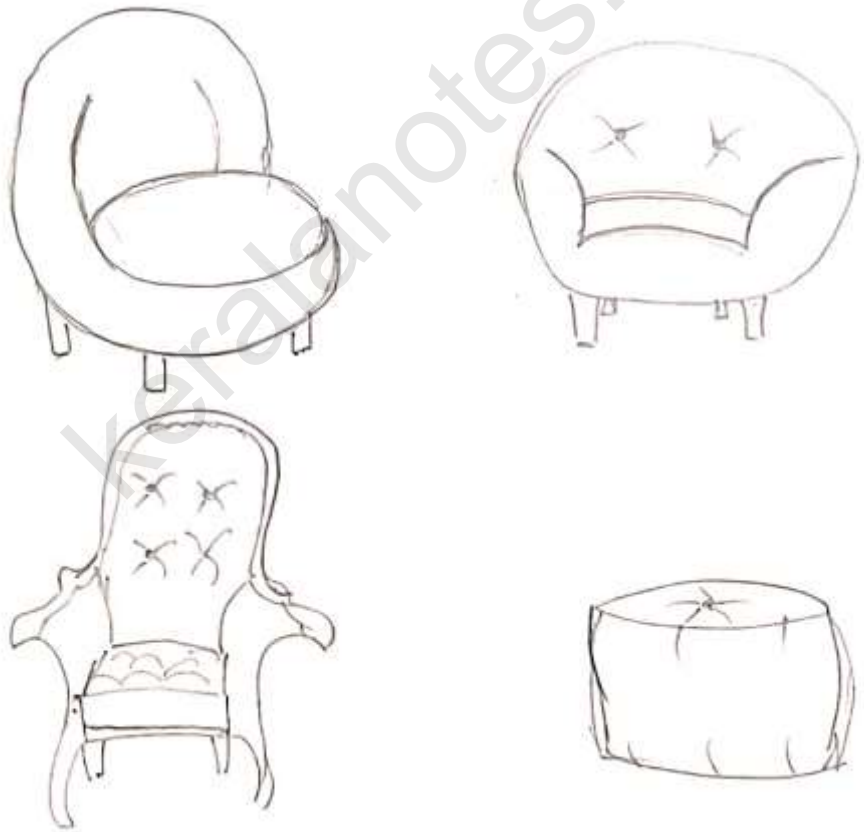
Material used

- For better comfort we can use cushion and sponge materials for inside of sofa
- The frame material can be used of good quality wood
- The sofa covering material can be made of good quality washable synthetic leather for long lasting and to avoid getting dirty

To develop an ergonomic design (for a product or system), the designer will have to consider and analyse anthropometric data (dimensions of human body), posture of working while using the product, kind of movements and kind of workspace. Ultimately, ergonomic design involves every aspect of user-product interaction, for the comfortable utilization of a product

Aesthetic design

- In aesthetic design we are focussing on the beauty and look of the sofa
- We also consider some other aspects like quality and strength of the material used
- By considering the basic sofa design concepts and measurements we can alter the design of the sofa
- The design of the sofa must be attractive than ergonomic
- Some of the aesthetic designs are given below



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