


Name:			
Enrolment No:			
UPES End Semester Examination, December 2024			
Course: Reverse Engineering Program: B.Tech Mechanical Engineering Course Code: MECH 4049		Semester: VII Time : 03 hrs. Max. Marks: 100	
Instructions: All the questions are compulsory.			
SECTION A (5Qx4M=20Marks)			
S. No.		Marks	CO
Q 1	Define Forensic Engineering and list its key applications in failure investigations.	4	CO1
Q 2	Explain how Force Flow Diagrams help in visualizing the transfer of energy within a system.	4	CO1
Q 3	Explain how do optical properties like color and camouflage contribute to the usability of materials in various industries?	4	CO1
Q 4	List activities that are not considered reverse engineering.	4	CO1
Q 5	Explain how transparency and absorption affect the selection of materials for optical applications.	4	CO1
SECTION B (4Qx10M= 40 Marks)			
Q 6	Explain the role of Form, Fit, and Function (FFF) in design and manufacturing. How do FFF assessments support modularity, standardization, and part interchangeability? Provide examples.	10	CO2
Q 7	How might Force Flow Diagrams assist in selecting appropriate materials for components handling significant forces?	10	CO2
Q 8	Evaluate the importance of redundancy in design. How does the absence of redundant components increase the risk of complete system failure?	10	CO2
Q 9	Identify methods for detecting and mitigating dynamic instability issues such as resonance, imbalance, and misalignment in mechanical systems.	10	CO2
SECTION-C (40 Marks)			
Q 10	Case Study: Designing a Multi-Tool for Diverse Applications Based on Form, Fit, and Function ToolMaster Corp., a well-known manufacturer of high-quality hand tools, set out to design a versatile multi-tool that could cater to diverse	40	CO3

customer segments, including outdoor enthusiasts, maintenance professionals, and casual home users. Each segment presented unique needs, which required ToolMaster to consider the principles of form, fit, and function carefully. The challenge was to create a single product line that could serve distinct purposes for each type of user while remaining cost-effective and durable.

For outdoor enthusiasts, the multi-tool needed to be compact and lightweight, with easy portability for camping and hiking. This version included essential tools like a knife, mini saw, screwdriver, and bottle opener, along with an emergency whistle. The form was kept small to fit easily in backpacks or on belts, while the fit was tailored for one-handed use with a grip that works for both gloved and bare hands. In contrast, maintenance professionals required a more robust, durable version of the tool that could withstand frequent use in demanding environments. This model was larger, made with heavy-duty materials, and included features such as pliers, a small wrench, and wire cutters. The fit was ergonomically designed to prevent hand strain during prolonged use, and the tool's function was optimized to handle mechanical and electrical repair tasks effectively.

The third model was designed for casual home users. Sleek and minimalist, this version was compact enough to be stored easily and had a smooth, safe grip suitable for infrequent use. The function was simplified to include basic tools like a bottle opener, scissors, a screwdriver, and a knife, aligning with common household tasks. Each of these design choices was influenced by the intended market segment's specific requirements, ensuring the tool's form, fit, and function matched the needs of each user type.

ToolMaster faced several design challenges, including balancing durability and portability, ensuring ergonomic compatibility across varied hand sizes, and managing manufacturing costs. By addressing each challenge, the company was able to deliver a product line that was not only versatile but also appealing to a broad customer base. This case highlights the importance of form, fit, and function in product design, particularly when catering to diverse market needs, and demonstrates how ToolMaster successfully balanced these principles to create a high-quality, multipurpose tool lineup.

Answer the following questions:

A. Applying (10 Marks)

- i. Identify another potential user group for ToolMaster's multi-tool, and propose one modification in "form, fit, or function" that would cater to this group.

OR

- ii. Demonstrate how the multi-tool for maintenance professionals might be used to perform a specific task, considering its design and functionality.

B. Analyzing (10 Marks)

	<p>i. Compare the design requirements for the outdoor enthusiast model and the maintenance professional model, focusing on form, fit, and function.</p> <p style="text-align: center;">OR</p> <p>ii. Examine how ToolMaster Corp. balanced durability and portability in the design of the multi-tool. What trade-offs were made?</p> <p>C. Evaluating (10 Marks)</p> <p>i. Justify whether ToolMaster's choice to prioritize ergonomics for the maintenance professional model was a sound design decision.</p> <p style="text-align: center;">OR</p> <p>ii. Assess the effectiveness of the minimalist design approach for casual home users. How well does it serve the needs of this segment?</p> <p>D. Creating (10 Marks)</p> <p>i. Design a fourth version of the multi-tool for a specific professional field (e.g., medical or culinary) that considers unique form, fit, and function requirements.</p> <p style="text-align: center;">OR</p> <p>ii. Formulate a marketing strategy for one of the multi-tool versions that emphasizes its alignment with the intended user segment's needs.</p>		
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