Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20712

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fifth Semester

Industrial Engineering

CME 341 – DESIGN FOR X

(Common to: Industrial Engineering and Management / Mechanical Engineering / Mechanical and Automation Engineering / Mechatronics Engineering and Robotics and Automation)

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State any two design for manufacturing (DFM) guidelines/principles.

2. Show the dependency of tolerance on manufacturing processes for sizes and surface roughness.

3. Write the significance of material selection and standardization on form design.

4. List any three design considerations of casting.

5. Give an illustrated example for the machining considerations that have to be taken into account while designing a component.

6. List any four advantages of robot based assembly automation.

7. Specify the design aspects that have addressed in the following design as shown in Figure 1 for facilitating manufacturing.

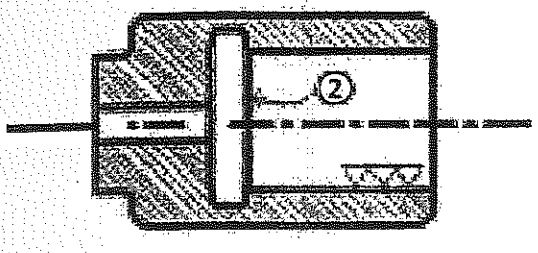


Fig. 1

8. What are cast holes and cored holes? Illustrate with simple examples.

9. List down any four unique capabilities of additive manufacturing.

10. State the significance of "Design for Complexity" in additive manufacturing.

PART B — (5 × 13 = 65 marks)

11. (a) Identify the functional and manufacturing datum for the component as shown in Figure 2 and change the datum for ease of manufacturing.

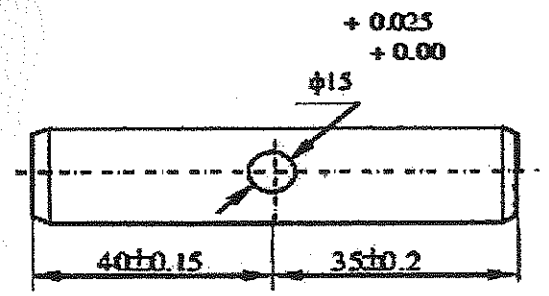


Fig. 2

Or

(b) Two circular plates of diameter 150 mm, each having 5 hates of nominal size 12 mm are to be assembled using M12 fasteners. The holes are equally distributed at a pitch circle diameter (ϕ) of 90 mm, The holes are produced by reaming process in a machining centre having a position accuracy of diameter 0.10 mm. If each plate has a centre hole of ϕ 38H8, determine

(i) Dimension of two plates to facilitate assembly by satisfying the appropriate assembly criterion. (7)

(ii) Re-dimension the assembly/components by following zero true position tolerance. (6)

12. (a) Figure.3 shows the current design of a stainless steel forging. The spacing between the radial ribs is 22". Assume that you have been assigned the task of redesigning the forging so as to reduce manufacturing costs. What suggestions would you make? Explain your reasoning in detail.

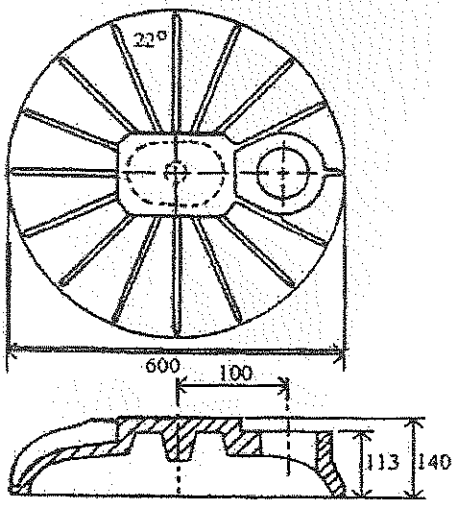
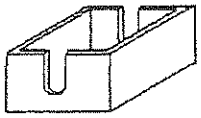


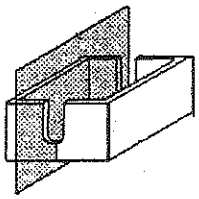
Fig. 3 stainless steel forging (All dimensions in mm)

Or

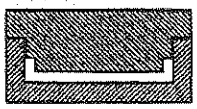
(b) Figure 4a shows an injection-moulded part with two grooves in the side walls. These grooves as you may recall, are called side shutoffs. Figures 4 (c) and 4 (d) shows two alternative mould designs for producing the part. From the point of view of machining, which mould is less costly to produce? Are there any difficulties, other than machining difficulties with either of these moulds?



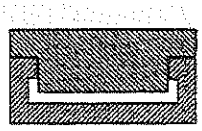
(a) Part to be molded



(b) Part with cutting plane through grooves



(c) Sectional view of mold for creating part



(d) Sectional view of alternative mold for creating part

Fig. 4 Injection moulded part

13. (a) With the help of examples, explain the principles of (i) Amalgamation and (ii) separation which can be adopted while designing products to simplify their machining processes.

Or

(b) Elucidate the rules and methodologies used to design, components for manual, automatic, and flexible assembly.

14. (a) Choose a parting line for casting the motor bed shown in Fig.5. How many number of cores should be used for your design? Draw the cross sectional view of cope and drag box assembly incorporating the mould cavity and cores (if any) in it.

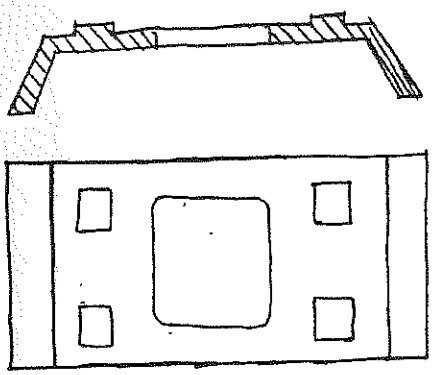


Fig.5 Motor bed

Or

(b) An engine cylinder head (Fig.6) produced through casting, analyze the critical aspects of parting line determination, the significance of minimizing cores, and potential modifications in the design and manufacturing process to optimize the quality and cost-effectiveness of the cast component (Cylinder head). Discuss in detail how these factors impact the casting process and the overall performance of the part.

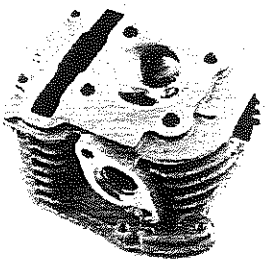


Fig. 6 Single cylinder Engine head

15. (a) How can Additive Manufacturing (AM) and Design for Manufacturing and Assembly (DFMA) principles be effectively applied to the redesign of exhaust manifolds (Fig.7) for improved performance and cost-efficiency in the automotive industry? In your response, discuss the AM-based design, address the significance of part orientation, removal of supports in the part. Also, discuss the potential benefits and challenges of implementing these concepts in exhaust manifold design.

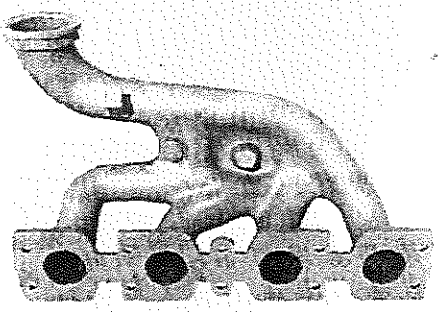


Fig.7. Exhaust manifold

Or

(b) Within the realm of fuel tank design for two-wheelers (Fig. 8), how can the principles of Design for Additive Manufacturing (DFAM) be effectively employed to innovate the construction of a lightweight. efficient fuel tank, utilizing additive manufacturing techniques? Discuss the strategic implementation of additive manufacturing based part orientation and the removal of supports to optimize manufacturability and performance, while considering design features like hollowing out parts and the incorporation of undercuts to maximize fuel capacity and structural integrity.

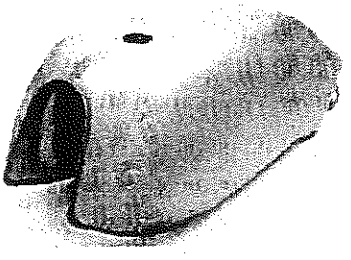


Fig.8. Two wheeler Petrol tank

PART C — (1 × 15 = 15 marks)

16. (a) For the cast iron support bracket shown in Fig. 9. (i) Indicate the preferred parting line and any necessary sand cores. (ii) Offer a design modification that will reduce or eliminate the need for sand cores.

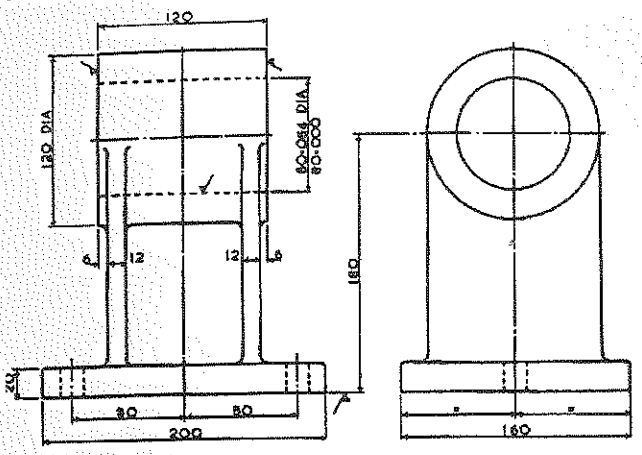


Fig. 9 Support Bracket-Cast Iron

Or

(b) The link stud shown in Figure 10 is to be manufactured in batches of 100.

(i) Prepare a suitable operation sequence layout for the stud

(ii) Identify the functional and manufacturing datums for the stud.

(iii) If needed, re-dimension the stud to make it suitable for manufacture.

(iv) Re-draw the stud showing appropriate manufacturing dimensions.

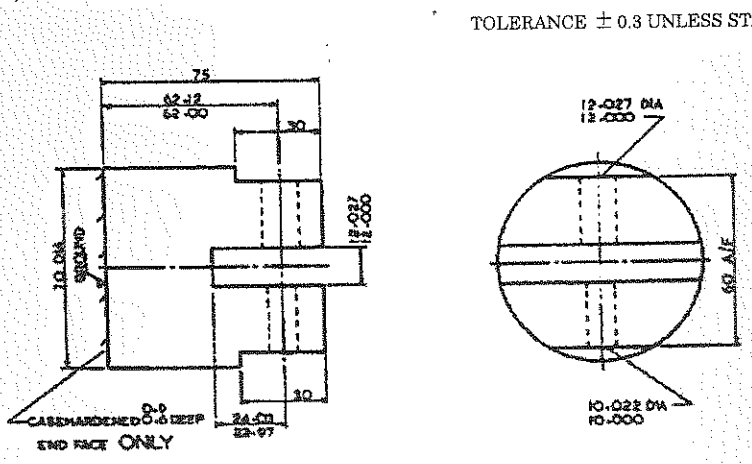


Fig. 10 Link Stud Mild Steel