Roll. No. | | | | | | | | | | | | |

**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

**B.E. (Full Time) - END SEMESTER EXAMINATIONS, Nov / Dec 2024**

MANUFACTURING ENGINEERING

# MF5502 - METAL AND POWDER FORMING

(Regulation 2019)

Time: 3 hrs | Max. Marks: 100

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| CO 1 | Illustrate deformation types and classification of forming processes. |
| CO 2 | Describe bulk forming processes and their applications. |
| CO 3 | Elaborate different sheet metal forming processes and their applications. |
| CO 4 | Compare and distinguish conventional and special forming processes. |
| CO 5 | Discuss powder forming processes and its applications |

**BL – Bloom's Taxonomy Levels**

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analyzing, L5 - Evaluating, L6 - Creating)

**PART- A (10 x 2 = 20 Marks)**
(Answer all Questions)

| Q. No | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1. | Why are metals with a BCC crystal structure less ductile compared to metals with an FCC crystal structure? | 2 | CO 1 | L2 |
| 2. | Which type of stress causes plastic deformation in a ductile material?<br>A) Compressive stress B) Tensile stress<br>C) Shear stress D) All of the above | 2 | CO 1 | L3 |
| 3. | What is the most common cause of cracks in forged parts? | 2 | CO 2 | L2 |
| 4. | What is the effect of friction between the rolls and the workpiece during rolling? | 2 | CO 2 | L2 |
| 5. | What does the Forming Limit Diagram (FLD) represent? | 2 | CO 3 | L2 |
| 6. | What is meant by the term "formability"? | 2 | CO 3 | L2 |
| 7. | What is high speed extrusion? | 2 | CO 4 | L2 |
| 8. | What is the key advantage of isothermal forging over conventional hot forging? | 2 | CO 4 | L2 |
| 9. | How are powder particle sizes characterized and what methods are used to determine their distribution? | 2 | CO 5 | L2 |
| 10. | Mention two advantages of powder metallurgy for manufacturing aerospace components. | 2 | CO 5 | L3 |

**PART - B (5 × 13 = 65 Marks)**

| Q. No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 11 (a) | Explain how temperature affects cold, warm, and hot working on material properties like strength and ductility. Compare their advantages, disadvantages, and impact on cost and energy consumption. | 13 | CO1 | L2 |
| | **OR** | | | |

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|---|---|---|---|---|
| 11 (b) | Explain elastic and plastic deformation, highlighting differences in stress, strain, and energy. Discuss their impact on material properties and provide examples of relevant materials and applications. | 13 | CO1 | L2 |
| | | | | |
| 12 (a) | Explain the concept of plastic deformation in the rolling process, focusing on the significance of the neutral point. How does the neutral point affect the distribution of stress and strain during rolling? | 13 | CO2 | L2 |
| | **OR** | | | |
| 12 (b) | Explain the processes of direct, indirect, tubular, and hydrostatic extrusion with neat sketckes. Compare these methods in terms of their working principles, advantages, and limitations. | 13 | CO2 | L2 |
| | | | | |
| 13 (a) | Explain the concept of Forming Limit Diagrams (FLDs) in sheet metal forming with neat sketch. Discuss how FLDs are used to predict the formability of materials during forming processes. | 13 | CO3 | L2 |
| | **OR** | | | |
| 13 (b) | Explain the working principles of Explosive Forming and Electromagnetic Forming (EMF). Include neat sketches to illustrate the processes and highlight their applications and advantages. | 13 | CO3 | L2 |
| | | | | |
| 14 (a) | Explain the fine blanking process and how it differs from conventional blanking in terms of edge quality, accuracy, and surface finish. | 13 | CO4 | L2 |
| | **OR** | | | |
| 14 (b) | Explain the working principles of hot isostatic pressing (HIP) and cold isostatic pressing (CIP). | 13 | CO4 | L2 |
| | | | | |
| 15 (a) | Describe various methods of powder production, such as atomization, chemical reduction, and electrolysis. Provide examples of metals suitable for each method. | 13 | CO5 | L2 |
| | **OR** | | | |
| 15 (b) | Explain the key Design for Manufacturing (DFM) considerations in powder metallurgy. Highlight the limitations of powder metallurgy, such as the difficulty in achieving sharp corners, thin walls, and other complex geometries | 13 | CO5 | L2 |



**PART- C (1 x 15 = 15 Marks)**
(Q.No.16 is compulsory)

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|---|---|---|---|---|
| 16 | Forging is widely used in the production of turbine blades for jet engines (See Fig 1) due to its ability to deliver high strength and durability. Based on your understanding of turbine blade design, provide a detailed step-by-step procedure for manufacturing these blades through forging. In your response, discuss key design factors such as material selection, blade geometry, and cooling requirements. Outline the forging process, from billet preparation to final shaping, and address common challenges such as material defects, dimensional accuracy, and high-temperature handling. | 15 | CO1 | L3 |

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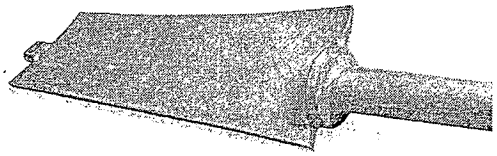
|---|---|---|---|---|
| ● | Finally, propose methods to overcome these challenges and ensure the production of high-quality turbine blades suitable for jet engine applications.<br>  <br>Fig. 1 A forged turbine blade (No dimensioning needed for this image) | | | |

ADDITIONAL CONTROLLER OF EXAMINATIONS
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CHENNAI
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