B.E. PRODUCTION ENGINEERING

THIRD YEAR, SECOND SEMESTER EXAM 2024

METAL FORMING

Time: 3 hours. Full Marks 100

Answer any **FIVE** questions, taking any **THREE** from Group-A and any **TWO** from Group-B.

All parts of a question (a, b etc) should be answered in one place.

GROUP—A

1. (a) A 50mm diameter forging billet is decreased in height (upset) from 100mm. to 50mm.
   (i) Determine the average axial strain and the true strain in the direction of compression.
   (ii) What is the final diameter of the forging?
   (iii) What are the transverse plastic strains?
   (b) When a compressive force of 400 tonnes (metric) is applied to the top surface of a well lubricated cube it just causes plastic flow. The cube is 80mm on each edge. What force would be required to produce flow if the face of the cube other than the top were constrained by die forces 100 and 200 tonnes?

   8+ 12

2. (a) Explain the optimum die angle, first critical angle, and second critical angle in the drawing operation. Write down the expression for the optimum die angle. What is center bursting in drawing operation?
   (b) The strain hardening of an annealed metal is expressed by $\sigma = 1400 \varepsilon^{-0.8}$, where stress is in MPa. A 25-mm-diam bar is drawn down to 20 mm and 15 mm in two steps using tapered cylindrical dies. Determine the plastic work per unit volume for each reduction.

   10+ 10

3. (a) Describe impact extrusion with neat sketch. Write the application.
   (b) Discuss various extrusion defects.

(c)The following equation expresses the pressure for the extrusion of aluminum bar:

$$p = \sigma_0(0.47 + 1.2\ln R)e^{4\mu L/D}$$

Billets 200 mm in diameter and 400mm long are extruded into 19mm diameter bars. In order to increase the length of the product by 3m, would it be more economical in terms of pressure to increase the billet length or the diameter? (Assume μ =0.1)

5+ 5+ 10

4. (a) Describe three high rolling mill and discuss its advantages.
   (b) Determine the maximum possible draft considering unaided bite.
   (c) Determine the roll torque for strip rolling indicating the assumptions used in the method.
   (d) Sketch a roll pressure versus angular coordinate curve. What does it signify?

3+ 4+ 10+ 3

5. (a) Derive expressions for pressure distribution in forging of a cylindrical disc considering both sliding and sticking friction.
   (b) A circular disc of lead of radius 150 mm and thickness 50 mm is reduced to a thickness of 25 mm by open die forging. If the coefficient of friction between the job and the die is 0.25, determine the maximum forging force. The average shear yield stress of lead can be taken as 4 N/mm^2.

10+ 10

GROUP-B

6 (a) Derive an expression for deep drawing force. Indicate the assumptions.
   (b) Determine the total forging load per unit width of the flat Workpiece forged between a fixed platen and a moving platen considering sliding friction throughout the interface. State the different assumptions clearly.

10+ 10

7. (a) Explain the following forming operation
   (i) Hydrostatic extrusion
   (ii) Tube piercing
   (iii) Stretch bending
   (iv) Thread rolling
   (b) Explain the reasons for strain hardening.
   (c) Discuss the advantages and limitations of hot and cold forming.

8+ 4+ 8

8. (a) Considering sliding friction throughout the interface show that average deformation pressure (mean height of the friction hill) for a cylindrical disc is given by

$$P_{av} = \frac{\sigma_0}{2}\left(\frac{h}{\mu R}\right)^2\left[e^{\frac{2\mu R}{h}} - \frac{2\mu R}{h} - 1\right]$$

Where, P_{av} = average deformation pressure

R and h = radius and height of the disc at the end of the forging operation.

μ = coefficient of friction

σ_0 = yield point stress

(b) Write short notes on any two

(i) Wavy edge

(ii) Zipper break

(iii) Alligatoring

14+6