

B.E. PRODUCTION ENGINEERING THIRD-YEAR SECOND SEMESTER - 2022

METAL FORMING

Time: 3 hours.

Full Marks 100

Answer any FIVE questions

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

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 optimum die angle, first critical angle and second critical angle in drawing operation. Write down the expression for optimum die angle. What is center bursting in drawing operation?
- (b) The strain hardening of an annealed metal is expressed by $\sigma = 1400\epsilon^{0.8}$, 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:

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

[Turn over

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 $\mu=0.1$)

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 average roll pressure for strip rolling indicating the assumptions used in the method of roll pressure evaluation.
 (d) Calculate the rolling load if steel sheet is hot rolled 30 percent from a 40 mm thick slab using a 1200 mm diameter roll. The slab is 760 mm wide. Assume coefficient of friction is 0.30. The plane-strain flow stress is 140 MPa at entrance and 200 MPa at the exit from the roll gap.

3+4+6+7

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/mm².

10+10

- 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 of strain hardening.
 (c) Discuss the advantages and limitations of hot and cold forming.

8+4+8