BACHELOR OF PRODUCTION ENGINEERING EXAMINATION, 2019,

(3RD Year-2nd Semester)

MATERIAL 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 a one place.

GROUP – A

1 (a) State Von Mises' maximum distortion energy criterion and show that

$$(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2 = 2\sigma^2_{y.p.}$$

where σ_1, σ_2 and σ_3 are the principle stresses and $\sigma_{y.p}$ is the tensile yield stress.

(d) A 24 mm-thick plate is decreased in thickness according to the following schedule: 12, 6, 3 mm. Compute the total strain on the basis of initial and final dimensions and the summation of the incremental strains, using

(i) conventional strain and

(ii) true strain.

How does this show an advantage for the use of true strain in metal-forming work?

12+8

2 (a) Explain formability, hardness and toughness.

(b) Show three simplified form of stress-strain curves.

(c) True stress and strain curve a prismatic bar of cross-sectional area A_0 is expressed by $\sigma = K\epsilon^n$. Find out the maximum load considering tensile instability.

(d) A bar of material has a stress strain curve given by $\sigma = 50\varepsilon^{0.5}$, σ is in tons per sq. inch. Such a bar which has already received an engineering tensile strain of 0.25, is to be pulled in tension until it begins to neck. What further engineering strain may be expected?

4+3+6+7

3 (a) Derive the following expression for cylindrical wire or rod drawing clearly stating the different assumptions

$$\frac{\sigma_d}{\bar{\sigma}_{yp}} = \frac{1+B}{B}\left[1-(1-r)^B\right] \qquad \text{Where } B = \mu\cot\alpha$$

σ_d = drawing stress

$\bar{\sigma}_{yp}$ = average yield stress

μ = coeff of friction

r = fractional reduction of area

α = semi die angle

(b) Fig.3(b) shows initial configuration (i. e. before application of load) of a structure consisting of two bars AC and BC pin-jointed at A, B and C and their initial cross-sectional area is A0. Bars AC and BC are of metal whose true stress and engineering strain curve is expressed by $\sigma=B\varphi m$. Considering tensile instability show that

$$W_{\max} = 2A_0 B m^m (1-m)^{1-m}\sqrt{1-\left\{\frac{h_0(1-m)}{l_0}\right\}^2}$$

Where is the maximum load, the truss can carry.

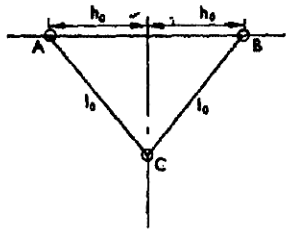

Fig.3(b)

12+8

4 (a) Determine the roll pressure for strip rolling with front and back tensions indicating all assumptions used in the method of roll pressure evaluation. Also determine the roll separating force driving torque and power.

(b) Explain the various methods of controlling the bending deflection of the rolls.

15+5

5 (a) Describe conventional and reverse redrawing with neat sketches.

(b) What is ironing?

(c) Discuss on common defects in deep drawing operation.

(d) What is Limiting Drawing Ratio (LDR)? Show that incase of frictionless deep drawing

Limiting Drawing Ratio (LDR) = e.

4+4+4+8

GROUP – B

6 (a) Explain the following bending operation

(i) Multistage bending
(ii) Tube bending
(iii) Stretch bending
(iv) Roll bending

(b) A 20 mm x 20 mm x 160 mm copper plate is forged between two flat dies to a final size of 10 mm x 40 mm x 160 mm. The co-efficient of friction is 0.2 and the tensile yield stress of copper can be taken as 70 N/mm^2. Determine the peak forging force

(i) Assuming no strain hardening.

(ii) Assuming the strain hardening characteristics for copper as

$\sigma_y = 70 + 30\varepsilon^{0.33}$ N/mm^2

8+12

7 (a) Determine the total forging load per unit width of the flat workpiece forged between a fixed platen and moving platen considering sliding (Coulomb) friction throughout the interface. State different assumptions clearly.

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

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

[Turn over

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

10+10

8 (a) Discuss on various defects in rod drawing.

(b) A common phenomenon is "die ringing," circumferential wear at the die entrance. Show that the maximum die pressure occurs at this location.

(c) Write short notes on following rolling defects:

(i) Edge cracking

(ii) Wavy edge

6+8+6