Ex/Prod/T/323/2017

BACHELOR OF PRODUCTION ENGINEERING EXAMINATION, 2017

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.

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**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 $\sigma_1$, $\sigma_2$ and $\sigma_3$ are the principle stresses and $\sigma_{y.p}$ is the tensile yield stress.

(b) An aluminum thin-walled tube (radius/thickness = 20) is closed at each end and pressurized to 7 MPa to cause plastic deformation. Neglect the elastic strain and find the plastic strain in the circumferential (hoop) direction of the tube. The plastic stress-strain curve is given by $\sigma = 100(\varepsilon)^{0.25}$ where stress is in MPa.

12+8

2 (a) Explain formability, hardness and toughness.

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

(c) Show that at the point of necking,

$$\frac{d\sigma}{d\varepsilon} = \sigma \quad \text{and} \quad \frac{d\sigma}{d\phi} = S$$

where $\sigma$ = true stress, $\varepsilon$ = true strain
and S = engg. stress, $\varphi$ = engg. strain.

(d) A bar of material has a stress strain curve given by $\sigma = 50\varepsilon^{0.5}$, $\sigma$ 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

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

$\sigma_d$ = drawing stress

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

$\mu$ = coeff of friction

$r$ = fractional reduction of area

$\alpha$ = semi die angle

(b) The strain hardening of an annealed metal is expressed by $\bar{\sigma} = 1400\,\bar{\varepsilon}^{0.5}$, 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.

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 different tube drawing operations with neat sketches.

(b) What are the adverse and beneficial effects of friction? Explain the purpose of lubrication.

(c) Show the variation of extrusion pressure with respect to punch displacement incase of direct extrusion and indirect extrusion.

(d) Discuss the advantages and limitations of hot and cold forming.

5+4+3+8

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 through out the interface. State different assumptions clearly.

(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

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

10+10

8 (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) 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:

(i) Tube bending

(ii) Wavy edge

(iii) Alligatoring

6+8+6