

MATERIALS PROCESSING
(MT 702)

Full Marks: 70

Time: 3 hrs

Use separate answer script for answering of each half.

First Half
(Answer ALL Questions)

1. Explain the importance of *friction* in rolling operation and derive the expression of maximum possible draft in rolling.

OR

Prove that the maximum reduction in area in drawing of wire in a single pass is 63%.

[5]

2. Answer the following questions (any THREE):

(i) (a) Discuss distribution of roll pressure along the *arc length of contact* and how this distribution gets modified by the application of front and/or back tension in the plane of rolling.

(b) Draw and level typical profile of a *wire drawing die* and mention specific functions.

(ii) Stating the relevant assumptions, derive the expressions of forging pressure in *plane strain* forging of a slab for *sliding friction* as well as *sticking friction* conditions by *slab-analysis method*.

(iii) Compare and contrast between:

(a) Direct extrusion and Indirect extrusion

(b) Open-die forging and Closed-die forging

(iv) Write short technical note on:

(a) Redundant work

(b) Rolling mill control

(v) Discuss the following defects, their causes and remedies with sketches:

(a) Alligatoring

(b) Fir-tree cracking

[10x3=30]

Second Half
(Answer ALL questions)

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3. Answer any TWO questions:

- (i) (a) Justify the use of ' J_2 ' as the suitable parameter for establishment of yield criteria, and hence, describe the Von Mises' yield criteria.
- (b) A structural member is to be designed with the safety factor of 1.8. The state of stress is given as $\sigma_x = 80$ MPa $\sigma_y = 120$ MPa and $\sigma_z = 180$ MPa. Obtain the desired yield strength of the material.
- (ii) (a) Explain the conditions necessary for dynamic recovery and recrystallisation during hot working.
- (b) A block of metal (20 mm \times 20 mm \times 120 mm) with $\sigma_o = 50$ MPa and $\mu = 0.25$ is pressed between the die to a size of 10 mm \times 40 mm \times 120 mm. Determine the pressure at the centre and at 5 mm out of the centre.
- (iii) (a) Determine the largest possible reduction for a 10 mm stainless steel wire having $\sigma_o = 1300e^{0.30}$ MPa, and $\mu = 0.25$ with the die having the die angle of 12° .
- (b) What is spring back? How to measure the same.
- (iv) (a) Compare between local and diffused necking.
- (b) Justify the effect of strain hardening exponent and strain rate sensitivity on necking.

[(5+5)x2=20]

4. Write short technical note on (any THREE):

- (i) Keller-Goodwin Diagram
- (ii) Necking limits
- (iii) Drawability limit
- (iv) Stretcher strain
- (v) Hodograph

[5x3=15]