MATERIALS PROCESSING
(MT 702)

Full Marks: 70   **Time: 3 hrs**

Use SINGLE answer script for answering of all questions.
Answer any SEVEN questions.

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

    (b) 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.

    [5+5]

2. (a) Discuss the design consideration of *flash* in close die forging. How flash cracking can be avoided?

    (b) What are the requisite characteristics of a lubricant to be used in materials processing. Name few lubricants used in hot and cold working processes.

    [5+5]

3. A SAE 1040 steel at the forging temperature has a yield stress of 40 MPa. A right-circular cylinder of 75 mm high and 25 mm diameter is to be upset to half height between flat dies.

    (a) If the coefficient of friction is 0.4, what is the maximum force required for the upsetting?

    (b) How much extra force is required over what would be needed if no friction were present?

    (c) If it takes 3 s to produce the forging and the efficient is 40%, how much power must be available in order to do the job?

    [4+3+3]

4. Discuss the following defects, their causes and remedies with sketches (*any* TWO):
    (a) Wavy edge
    (b) Alligatoring
    (c) Cold shut
    (d) Stretcher strain

    [5x2]

5. Write short technical note on (*any* TWO):
    (a) Workability limit diagram

(b) Rolling-mill control

(c) Seamless tube production

(d) Hydrostatic extrusion process

[5x2]

6. Differentiate between (*any* TWO):

(a) Open die forging and close die forging

(b) Direct extrusion and indirect extrusion

(c) Cluster rolling mill and planetary rolling mill

[5x2]

7. (a) What do you understand by the second invariant of stress deviator? Justify its use in the yield criteria.

(b) The stresses acting on a cubic element having the yield stress of 600MPa are as following:

σ_x= 180 MPa, σ_y= 110 MPa, σ_z= -300 MPa and τ_{xy}= 40 MPa.

Determine the safety factor.

[5+5]

8. (a) Compare the yield locus for plane stress as obtained from Von Mises and Tresca criteria.

(b) Establish that the two criteria are equivalent under plane strain condition.

[5+5]

9. (a) Enumerate the factors those contribute to the efficiency factor of the extrusion process.

(b) Determine the time average mean strain rate for extrusion of billet from the diameter D_b to D_a using the die with semicone angle of 45°. Calculate the strain rate for D_b = 180 mm and D_a = 40 mm.

[5+5]

10. (a) Obtain the draw stress for a wire reduced from the area A_a to A_b.

(b) Obtain the mean stress for 40% reduction in cross section of a wire for which the flow stress is given by $\sigma_o = 1400\ \varepsilon^{0.25}$.

[5+5]

11. (a) Show the distribution of stresses in the section of a drawn cup.

(b) Justify- *while the limit of drawing a wire is determined by the work hardening behavior of material, the same is not true for drawing a cup.*

[5+5]