MATERIALS PROCESSING
(MT 702)

Time: 3 hours   Full Marks: 70

Using SINGLE answer-script, answer ALL questions.

1. **(a)**   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.

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

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

    (iii)   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?

                                OR

    (b)   **(i)**   State *spread law* and define its different terms.

    (ii)   Differentiate between sliding friction and sticking friction conditions and mention respective mean forging pressures.

    (iii)   What is flash? Discuss the design consideration of its. How flash cracking can be avoided?

                            [4+3+3 **or** 3+3+(1+2+1)]

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

    (ii)   What is alligatoring defect? Using sketches, discuss the causes and remedies of this defect.

                                OR

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

    (ii)   Discuss the principle of automation for rolling mills.

                            [(2+3)+(1+2+2) **or** (2+3)+5]

3. **(a)**   **(i)**   Differentiate between direct extrusion and indirect extrusion with schematic diagrams.

    (ii)   Discuss the method of seamless tube production.

                                OR

    (b)   **(i)**   What is *dead-metal zone*? How can it be minimized? What is *chevron cracking*? Why does it occur? How can it be avoided?

    (ii)   What is the breakthrough pressure required for hot (315 °C) extrusion of aluminum (σ_o =83 MPa) to 77 mm diameter bar from a 300 mm diameter billet if μ=1.0? What capacity press is needed for this operation?

                            [5+5 **or** (1+1+1+1+1)+(3+2)]

4. **(a)** Stating the relevant assumptions, derive the stresses for drawing of wire in presence of friction by slab analyses as well as uniform deformation energy methods.

OR

(b) **(i)** What is redundant work? How its magnitude can be estimated? Explain the influence of semi-die angle on redundant work.

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

[(2+4+4) **or** (1+2+2)+5]

5. **(a)** **(i)** Discuss the construction and utilities of forming limit diagram.

(ii) What is springback? How it can be measured?

(iii) State the influence of clearance in shear process.

OR

(b) **(i)** What is *stretcher-strain*? Why and when does it occur? How it can be removed?

(ii) Define the following terms: Earing, Spinning, Ironing, Wrinkling, Superplastic deformation.

[5+(1+2)+2 **or** (1+2+2)+(1x5)]

6. **(a)** **(i)** What is graphene? Draw the structure of graphene and mention its important properties. Outline one method of preparation of grapheme.

(ii) State the selection criteria of material for gear application. Give two examples. Discuss the finished operations of gear manufacturing.

OR

(b) **(i)** What is rebar? Briefly discuss the heat treatment along with cross sectional microstructure of TMT steel rebar.

(ii) What is kevler? Mention its structure, important physical and mechanical properties as well as typical applications.

[(1+1+1+2)+(2+1+2) **or** (1+2x2)+(1+1+2+1)]

7. **(a)** **(i)** What is 3D printing? What are the steps for developing 3D print of any object? Describe one of them. State the disadvantages associated with 3D printing technology.

(ii) What is silicon wafer? Mention typical steps in the manufacturing of silicon wafer. Discuss the principle of zone-refining.

OR

(b) **(i)** State the types of pencil. Mention the controlling parameters of the composition of graphite pencil leads. How the quality control of leads is maintained?

(ii) State any two types of stent and their uses. Name few materials used for making of stents. State the steps of stent fabrication.

[(1+1+2+1)+(1+2+2) **or** (1+2+2)+(2+1+2)]