BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : VI**
BRANCH: PRODUCTION **SESSION : SP/18**

SUBJECT: PE6003 MATERIAL DEFORMATION PROCESS

TIME: **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1 Differentiate between the following: [12]
(i) Hot working and cold working (ii) Elastic Deformation and plastic deformation (iii) Engg stress and True stress (iv) Forging and Pressing (v) Upsetting and drawing out (vi) Direct Extrusion and Indirect Extrusion.

Q.2(a) Show that the normal stress on the plane of maximum shear stress is equal to the mean of the principal stresses from first principle. [2]

Q.2(b) Find out the differential equilibrium conditions of stresses is 3-cartesian co-ordinate system. [4]

Q.2(c) The general displacement field in a body is given as [6]
$U = 0.015x^2y + 0.03$
$V = 0.005y^2 + 0.03xz$
$W = 0.003z^2 + 0.001yz + 0.005$
Find strain and shearing strains at the point (1, 0, 2).

Q.3(a) What do you mean by volume strain? Derive expression for the volume strain. [2]

Q.3(b) Define flow curve Draw and explain the flow curves for the following materials: [4]
(i) Ideal plastic material (ii) Ideal plastic material with elastic region.
(ii) Strain Hardening material.

Q.3(c) The state of stress at a point is given by the following stress tensor. [6]

$$\sigma_{ij} = \begin{bmatrix} 10 & 1 & -8 \\ 1 & -6 & 6 \\ -8 & 6 & 20 \end{bmatrix} MPa$$

Determine (i) Stress Invariants (ii) Principal stresses (iii) Maximum shear stress.

Q.4(a) Find out the condition for the plastic instability. [2]

Q.4(b) Explain the following: [4]
(i) Levy-Mises Equation (ii) Prandtl-Reuss Equation.

Q.4(c) A compressive load of 4000 kN is applied to a well lubricated cube of metal of 80mm side and just causes yielding. What load would be required if other sides were constrained by forces of 1000 kN and 2000 kN respectively. Also find out the factor of safety. [6]

Q.5(a) Differentiate between Extrusion and Drawing. [2]

Q.5(b) Derive an expression for total forging load and Mean forging pressure for the forging of a strip under the combination of slipping and sticking. [4]

Q.5(c) A 20x20x160 mm copper plate is forged between two flat dies to final size of 10x40x160 mm. Determine the total forging load. Given $\sigma_{0_\omega} = 70MPa,\ \mu = 0.3$ [6]

Q.6(a) Differentiate between wet wire drawing and dry wire drawing. [2]

Q.6(b) Describe briefly the role of friction and lubrication in metal deformation process. [4]

Q.6(c) Find out the maximum reduction of area per pass in cylindrical drawing under cold condition under the following effect. Assume No back tension. [6]
(i) with friction when $\mu = 01$ and $\alpha = 6^0$. (ii) without friction

Q.7(a) Explain briefly about: (i) Liquid Metal forging (ii) Spray forming. [2]

Q.7(b) Find out the condition for biting a strip by roll. Establish relationship between maximum draft, radius of roll and coefficient of friction between roll and work-piece. [4]

Q.7(c) Mention the assumption in the analysis of cold strip rolling and derive an expression for roll pressure when strip is in between no slip point and exit section by taking an average value of contact angle α. [6]

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