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

CLASS: BE **SEMESTER : VI**
BRANCH: PROD **SESSION : SP/17**

SUBJECT: PE6003 MATERIAL DEFORMATION PROCESS

TIME: 03:00 **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.
6. Nothing should be written on front or back of the question paper except tick marking.

Q.1(a) What are the methods used for obtaining the useful shapes from the metal? What are the different types of material deformation process on the basis of type of forces applied to the work-piece? Describe briefly with suitable diagrams. [6]

(b) Differentiate between the following [6]
(i) Elastic deformation and plastic deformation
(ii) Forming process and machining process
(iii) Cold working process and hot working process

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

(b) The state of stress characterized by σ_{ij} is given below. Resolve the given state into hydroststic state and a pure shear state. Also find out invariants of pure shear state. [4]

$$\sigma_{ij=}\begin{bmatrix} 10 & 4 & 6 \\ 4 & 2 & 8 \\ 6 & 8 & 6 \end{bmatrix}$$

(c) The plane stress distribution in a flat of unit thickness given by [6]
$\sigma_{xx}= x^3y-2y^3x$, $\sigma_{yy}=y^3x-2pxy+qx$

$$\gamma_{xy} = \frac{y^4}{2} - \frac{3}{2}x^2y^2 + px^2 + s$$

If body forces are neglected, show that equilibrium exists.

Q.3(a) What do you mean by compatibility equations? Derive expressions for the condition of compatibility. [2]

(b) What do you mean by Bauschinger's effect? Explain with a suitable diagram. [4]

(c) A cube of certain metal is subjected to principal stress which are in the following proportion [6]
$\sigma_1 : \sigma_2 : \sigma_3 = 2:1:0$. Determine the magnitude of σ_1 for yielding according to (i) Von – Miss yield criteria & (ii) Tresca yield criteria. The tensile yield stress is 3000 kg / cm^2.

Q.4(a) What do you mean by flow curve? Draw and explain the flow curves for the following materials. (i) Ideal plastic material (ii) Ideal plastic material with elastic region (iii) strain hardening material. [2]

(b) Derive the Von-Miss flow conditions for the following state of stress:- [4]
(i) Plane strain (ii) Cylindrical state of stress.

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

$$\sigma_{ij}\begin{bmatrix} 4 & 3 & 1 \\ 3 & 2 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

Determine (i) stress Invariants (ii) Principal stress (iii) Maximum $\frac{w}{-}$ shearing stress.

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Q.5(a) Differentiate between sliding friction and sticking friction. Mention their condition also. [2]

(b) Explain briefly the role of Lubricants in the material deformation process. What are the factors required in selecting a Lubricant for material deformation process? [4]

(c) A circular disc of 100 mm diameter and 160 mm height is compressed to 40 mm height between two flat dies at 1000°c. Taking that there is sticking friction over the entire contact area of the disc, determine the Maximum $\frac{w}{-}$ die pressure and average die pressure. The yield strength of the material at 1000°c is 75 N/mm^2. [6]

Q.6(a) Distinguish between following [2]

(i) Forging and pressing

(ii) Extrusion and Drawing.

(b) Derive an expression for the determination of drawing stress in the wire drawing operation under frictionless condition. [4]

(c) A copper wire is annealed diameter to which it could be theoretically draw in under ideal condition. [6]
(i) In one pass (ii) In three pass.

Q.7(a) Explain briefly about the following [6]
(i) Explosive forming (ii) Isothermal forming (iii) Hydrostatic extrusion.

(b) (i) Find out the condition for biting a strip by rolls. [2]

(ii) Establish a relationship between Maximum $\frac{w}{-}$ draft , roll radius and coefficient of friction between the roll and work – piece. [4]

*******26/04/17******M**