**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(MID SEMESTER EXAMINATION)**

**CLASS: BE** **SEMESTER: VI**
**BRANCH: PRODUCTION** **SESSION : SP/2018**

**SUBJECT: PE6003 MATERIAL DEFORMATION PROCESS**

**TIME: 1.5 HOURS** **FULL MARKS: 25**

**INSTRUCTIONS:**
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

---

Q1 (a) Define and classify Manufacturing process. What are the consideration to be taken in selecting a suitable manufacturing process? Differentiate between Material deformation process and Machining process. [3]

(b) Differentiate the following Material deformation process. [2]
(i) Isoforming and Auoforming
(ii) Isostatic forming and Hydrostatic forming.

Q2 (a) The following stress field in a body is given as [3]
$\sigma_x = 80x^3 + y$ kg/cm$^2$ $\gamma_{xy} = 100(1+y^2)$ kg/cm$^2$
$\sigma_y = 100(x^3+10)$ kg/cm$^2$ $\gamma_{yz} = 0$ kg/cm$^2$
$\sigma_z = 10(9y^2+10z^3)$ kg/cm$^2$ $\gamma_{xz} = x(z^3+100xy)$ kg/cm$^2$
Find the expression for body force distribution necessary to satisfy the equilibrium equations. What are the body forces at point (1,1,5).

(b) Show that angles which locate planes of maximum/minimum shear stress make $45^0$ angle with the plane of the principal stress. [2]

Q3 The state of stress at a point given by the following stress tensor [5]

$$\sigma ij = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{bmatrix}$$

Determine (i) stress Invariants (ii) Maximum shearing stress.

Q4 (a) The general displacement field in a body is given as [3]
$U = 0.015x^2y + 0.03$
$V = 0.005y^2 + 0.03\ xz$
$W = 0.003z^2 + 0.001yz + 0.005$
Find the strain and rotation tensor i.e Eij and Wij at point (1,0,2)

(b) Show that strains given by the following expressions can exist in a deformable body [2]
$E_{xx} = y^2 + 5xy$, $E_{yy} = y^2x + x^2$, $E_{xy} = 2xy + y^2$

Q5 (a) If the values of E and G for an alloy $2x10^6$ and $8x10^5$ kg/cm$^2$ respectively. Find Lame's constt. Hence and otherwise if [3]

$$Eij = \begin{bmatrix} 0.001 & 0 & -0.002 \\ 0 & -0.003 & 0.005 \\ -0.002 & 0.0005 & 0 \end{bmatrix}$$

Compute the components of $6_{ij}$.

(b) Define strain Energy. Show that the derivative of Energy Density ($U_0$) with respect to any strain component gives the corresponding stress component. [2]

Q6 (a) What load is required to deform a cube of 80mm side if constraining forces on its sides are both 160 tons. Yield strength of the cube material could be taken as 60 ton/cm$^2$. [3]

(b) Derive Von-Miss flow condition under the following: - [2]
(i) Plane strain condition
(ii) Cylindrical state of stress condition.

:::: 22-02-2018 M ::::::