Total No. of Questions : 7]

SEAT No :

P5068

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[5060]-582

M.E. (Mechanical) (Design Engineering)

MATERIAL SCIENCE AND MECHANICAL BEHAVIOR OF MATERIALS

(2013 Credit Pattern) (502202) (Semester - I)

Time :3 Hours] *[Max. Marks : 50*

Instructions to the candidates:

1) ***Answer any five questions.***
2) ***Neat diagrams must be drawn whenever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of programmable calculators not permitted.***
5) ***Assume Suitable data if necessary.***

Q1) In a cubic unit cell, sketch the following: **[10]**

a) $[\bar{1}\,1\,0]$

b) $[\bar{1}\,\bar{2}\,1]$

c) $[0\,\bar{1}\,2]$

d) $[0\,\bar{1}\,\bar{2}]$

e) $[\bar{1}\,\bar{1}\,0]$

Q2) State of stress at a point in a body is given by $\begin{bmatrix} 10 & 0 & 3 \\ 0 & 3 & 0 \\ 3 & 0 & 2 \end{bmatrix}$. Determine- **[10]**

a) Octahedral normal stress.

b) Octahedral shear stress.

c) Maximum shear stress.

Q3) State of stress at a point is described by $\begin{bmatrix} 20 & -40 & 0 \\ -40 & -40 & 0 \\ 0 & 0 & 100 \end{bmatrix}$, using Mohr's circle determine the

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a) Principal stresses **[10]**
b) Octahedral stresses and
c) Maximum shearing stress

Q4) The stress -strain response in simple tension for an elastic -linear hardening plastic material is approximated by expression $\sigma = \sigma_0 + m\varepsilon^p$, for $\sigma \geq \sigma_0$. The material obeys Hook's law up to elastic limit. $\sigma_0 = 210$ MPa, E=210 GPa and $m = 26$ GPa. The Material sample is first stretched to a total strain $\varepsilon = 0.007$, is subsequently returned to its initial strain free state by continued compressive stressing and then is unloaded and reloaded in tension again to reach the same strain, $\varepsilon = 0.008$.Sketch the stress-strain curve for the following hardening rules: **[10]**

a) Isotropic hardening
b) Kinematic hardening

Q5) An element of J_2 - material (deformation theory of plasticity) is subjected to a proportional loading path with stress ratio $\frac{\sigma}{\tau} = 2.$ The material obeys Hook's law up to elastic limit. Post-yield behavior during simple tension of the material is given by $\varepsilon = \frac{\sigma}{e} + \frac{6 - 6_y}{m}$ with Young's modulus E=210 GPa, yield stress $\sigma_Y = 210$ Mpa, constant m=26 GPa and Poisson's ratio = 0.3. Find all the components of normal and shear strains for stress state of $\sigma = 200$ MPa and τ=100 MPa. **[10]**

Q6) Explain Residual stresses and Residual Strain in cylinder in torsion. **[10]**

Q7) Explain Viscoelasticity and Maxwell model for rheological properties of viscoelastic material. **[10]**

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