Page No. ____
Date

Section-2

Q1

Ans:→ Yield Criteria :-

• It is a hypothesis concerning the limit of elasticity under any possible combination, of stresses.

• Several yield criteria have been proposed have been to find out the relation b/w yield criteria stresses.

*→ Tresca's Theory :-

• It state that failure of a material (as plastic deformation) will occurs when the max. shear stress in a material reached the value of maximum shear stress at

• Let principal stresses at a point in the material are σ_1, σ_2 & σ_3 ($\sigma_1 > \sigma_2 > \sigma_3$)

So, maximum shear stress is given by

$$\frac{\sigma_1 - \sigma_3}{\sigma_2} = \tau_{max.}$$

• Plastic deformation occurs when $\tau_{max.}$ is equal to the K (K = maximum shear stress at elastic limit). So acc. to Tresca's theory of plastic deformation :-

$$\frac{\sigma_1 - \sigma_3}{2} = K \quad \text{—— (1)}$$

Page No. ____
Date

- For uniaxial tension condition,

$$\sigma_1 = \sigma_y$$
$$\sigma_2 = \sigma_3 = 0$$

- For uniaxial Compression Condition,

$$\sigma_1 = \sigma_2 = 0$$
$$\sigma_3 = -\sigma_y$$

- For uniaxial tension condition, put the value of σ_1 & σ_3 in eqn ①, we get

$$\frac{\sigma_y - 0}{2} = K$$

$$\boxed{K = \frac{\sigma_y}{2}}$$

- For uniaxial Compression condition, put the value of σ_1 & σ_3 in eqn ①, we get

$$\frac{0 - (-\sigma_y)}{2} = K$$

$$\boxed{K = \frac{\sigma_y}{2}}$$

*) Von Mises Theory :-
- It states that failure of a material will occur when the total shear strain energy per unit volume in strained material reaches a value equal

Page No. ______
Date

to the shear strain energy per unit unit volume at the elastic limit:

- Energy of distortion is given by :-

- $$U = \frac{1}{12G}\left[(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2\right]$$

here,

- "U" is the shear strain energy per unit volume, σ_1, σ_2 & σ_3 are the principle stresses; "G" is the shear modulus.

- So, $(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2 = 12G\times U$
$\Rightarrow C$

- For uniaxial tensile loading :-

$$\sigma_1 = \sigma_y, \quad \sigma_2 = \sigma_3 = 0$$

putting the value in above equ :-

$$(\sigma_y-0)^2+(0-0)^2+(0-\sigma_y)^2 = C$$

$$\boxed{2\sigma_y^2 = C}$$

- Considering yielding under pure tension, for pure shear, $\sigma_1 = K$, $\sigma_2 = 0$, $\sigma_3 = -K$

$$\therefore (K-0)^2+(0-(-K))^2+(-K-K)^2 = C$$

$$\boxed{6K^2 = C}$$

Page No.
Date

Now,

$$2\sigma_y^2 = 6K^2$$

$$\boxed{K = \frac{\sigma_y}{\sqrt{3}}}$$ Ans.