Sec-2- ans 1 ⇒ **Yield Criterion :—**

It is a hypothesis concerning the limit of elasticity under any possible combination of stresses. Several yield criteria have been proposed to find out the relation b/w yield criteria have been proposed to find out the relation b/w yield stresses.

⇒ **Tresca's Theory :—**

1. It states that failure of a material (or plastic deformation) will occur when the maximum shear stress in a material reaches the value of maximum shear stress at elastic limit.
2. Let principal stresses at a point in the material are σ_1, σ_2 and σ_3 $(\sigma_1 > \sigma_2 > \sigma_3)$ so maximum shear stress is given by.

$$\frac{\sigma_1 - \sigma_3}{2} = \tau_{max}.$$

3. Plastic deformation occurs when τ_{max} is equal to K (K = max. shear stress at elastic limit). So acc. to Tresca's theory of plastic deformation :—

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

4. For uniaxial tension condition,

$$\sigma_1 = \sigma_y$$

$$\sigma_2 = \sigma_3 = 0$$

5. for Uniaxial compression condition,

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

6. for Uniaxial tension condition, put the value of σ_1 and σ_3 in eq ①

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

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

7. for Uniaxial compression condition, put the value of σ_1 and σ_3 in eq ①.

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

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

Von Mises Theory :—

1. 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 to the shear strain energy per unit unit volume at the elastic limit.
2. Energy of distortion is given as :—

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

Here, U is the shear strain energy per unit volume, σ_1, σ_2 and σ_3 are the principal stresses, G is the shear modulus.

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

where, C = Constant.

4. For Uniaxial tensile loading,

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

Putting the value in above eq^n :-

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

$$2\sigma_y^2 = C$$

5. Considering yielding under pure tension,

for pure ~~stress~~ shear, $\sigma_1 = K$, $\sigma_2 = 0$, $\sigma_3 = -K$

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

$$6K^2 = C$$

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

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