Hooke's law :-

If a substance is subjected to stress below elastic limits it recovers completely when stress is removed (within elastic limit)

$$\text{Stress} \propto \text{Strain}$$
$$\Rightarrow \text{Stress} = E \cdot \text{Strain}$$
$$\therefore E = \frac{\text{Stress}}{\text{Strain}}$$ where $E \rightarrow$ modulus of elasticity

Types of Modulus of Elasticity :-

1) Young's modulus (Y) :- If strain is longitudinal, then modulus of elasticity is "Young's modulus"

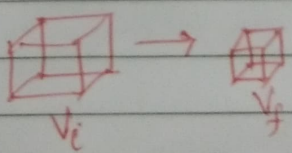
$$Y = \frac{\text{Longitudinal stress}}{\text{Longitudinal strain}} = \frac{F/A}{\Delta L/L}$$

2) Bulk's modulus (B) :- If strain is volume strain, then modulus of elasticity is "Bulk modulus"

(*) $$B = \frac{\text{Volume stress}}{\text{Volume strain}} = \frac{-\Delta F/A}{\Delta V/V_0}$$

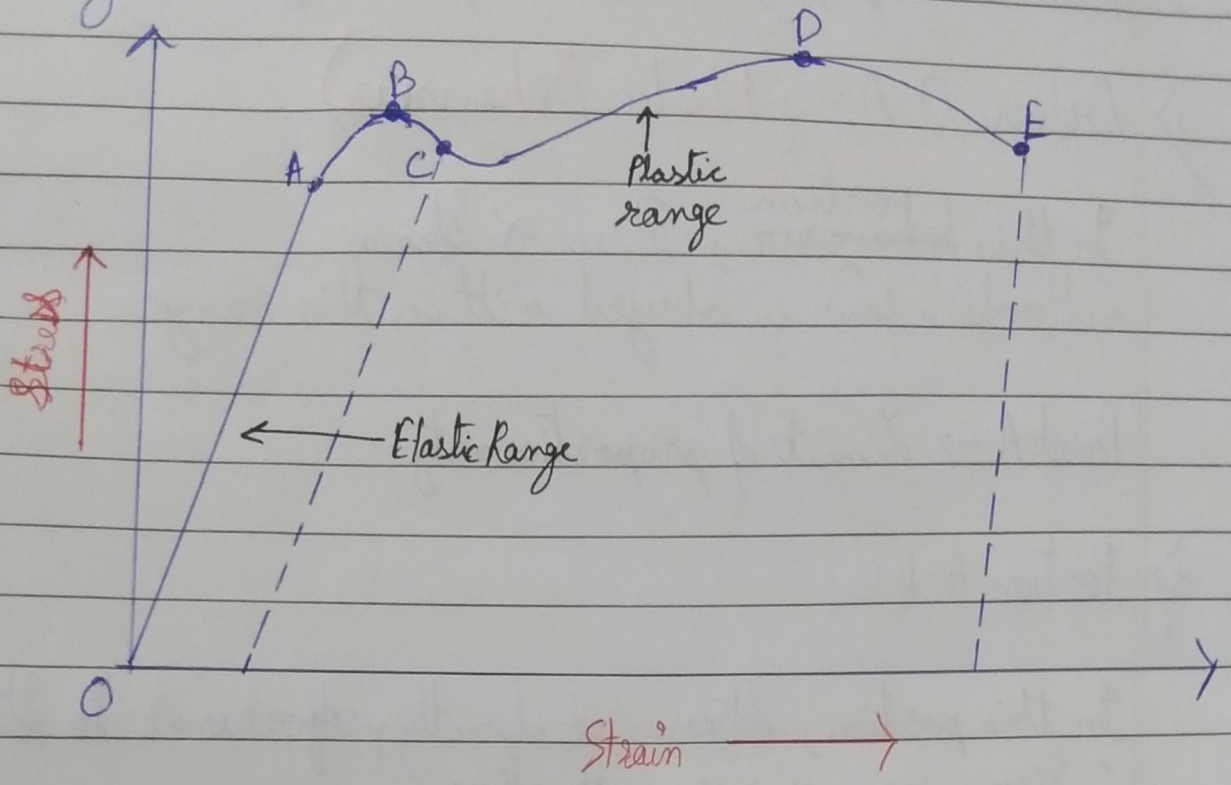
3) Shear modulus (S) :- If strain is sheer strain, then modulus of elasticity is "Shear modulus"

$$S = \frac{\text{Sheer stress}}{\text{Sheer strain}} = \frac{F/A}{\Delta x/h}$$

(*) '$-$' sign since 

$$\Delta V = V_f - V_i \rightarrow -ve \quad [V_f < V_i]$$

Graphically :-



Here,

A - Proportional limit
B - Elastic limit
C - Yield Point
D - Breaking point
E - Fracture point

From the above graph, we can understand the behaviour of material more clearly.

From the graph, we observe the following:-

1) Portion O-A:- (Elastic Behaviour)

In this portion, Stress ∝ Strain
∴ Hooke's law is obeyed within this range

Point A → Limit of proportionality

2) Portion A-B:-

In this portion, Stress is not directly proportional to Strain
∴ Strain increases more with stress

Point B → Elastic limit
It is the maximum stress which a body can sustain and still regain its original shape (if load is removed)

3) Portion B-C:-

In this portion, the load is increased beyond elastic limit

Point C → Yield Point
After load is removed, the body does not regain its original shape

4) Point C-D:-

In this portion, the body stretches rapidly till point D (highest point)

Point D → Breaking Point

5) Point E:-

In this portion, even a little stress will cause the body to break

Point E → Fracture Point