Properties of Matter

Unit – 1

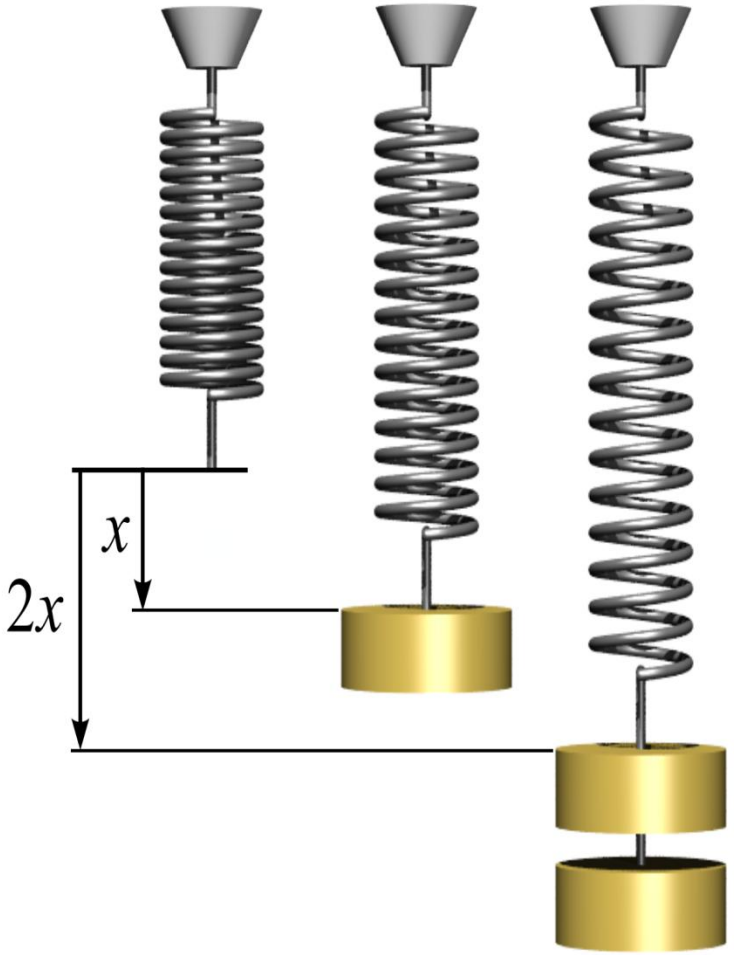
Physics (3110011)

Concept of Load, Stress and Strain

1. Load: Combination of external forces applied on the object/body.

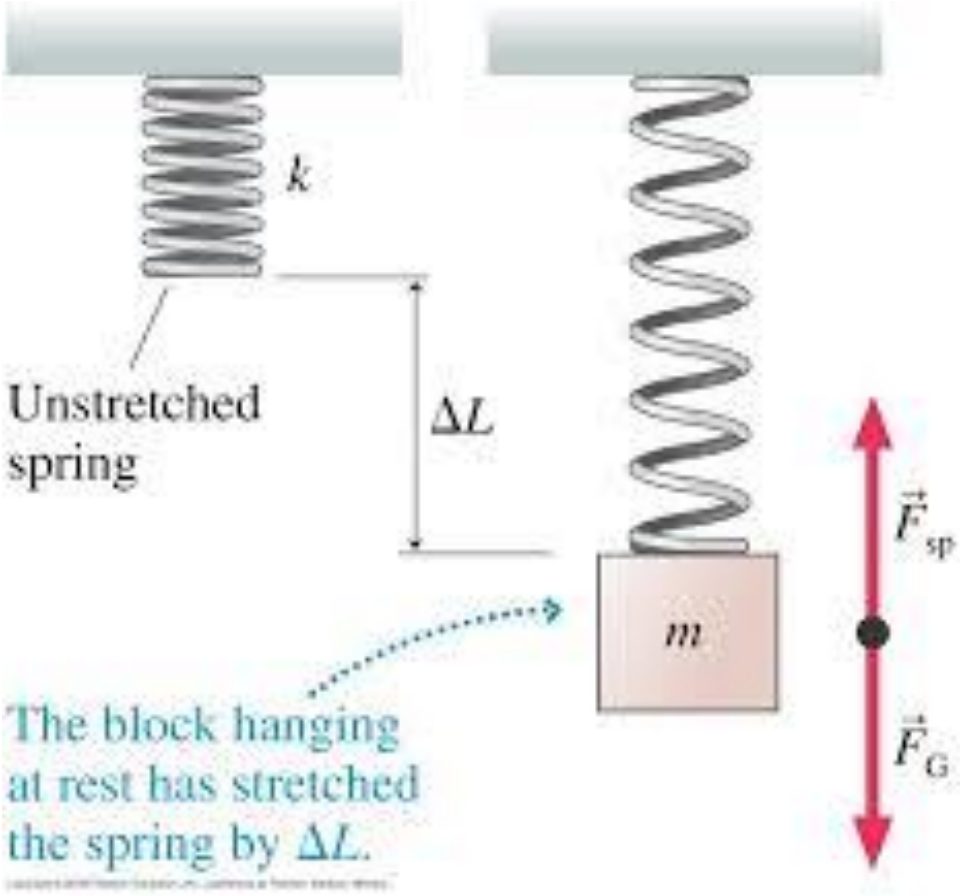
   - Effect: Body changes its dimensions/shape.

   - Load is also called ‘deforming force’.



2. Stress

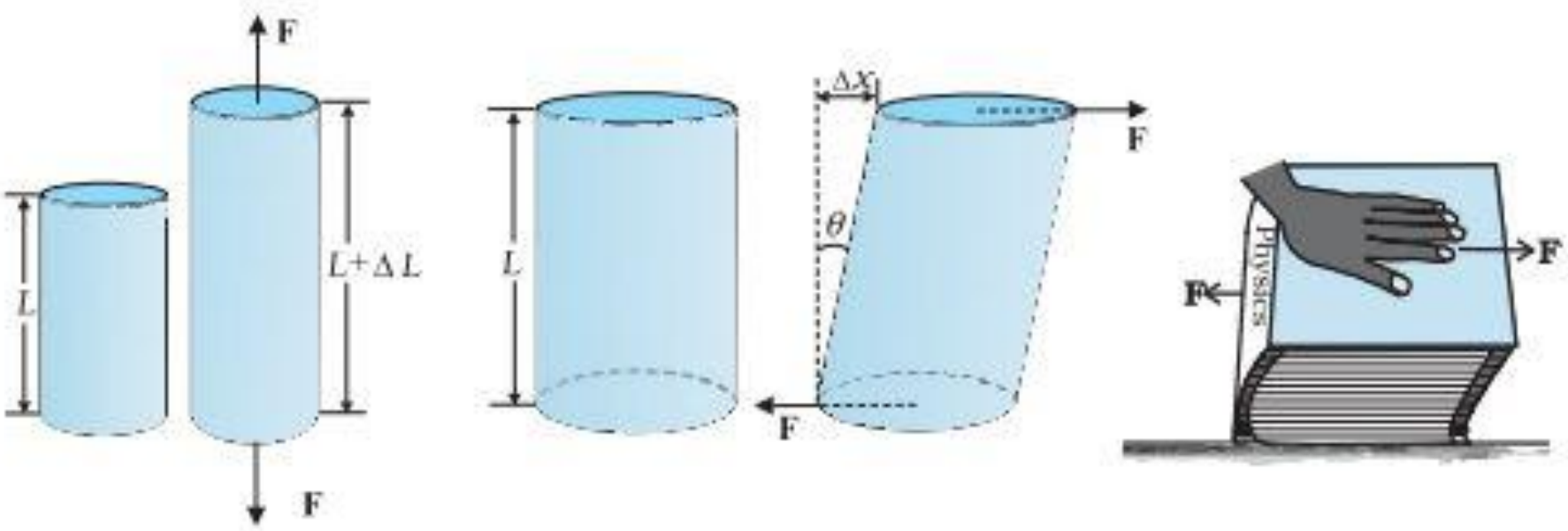
- Restoring force per unit area developed within the body on application of load is called stress.



2(A). Types of Stress

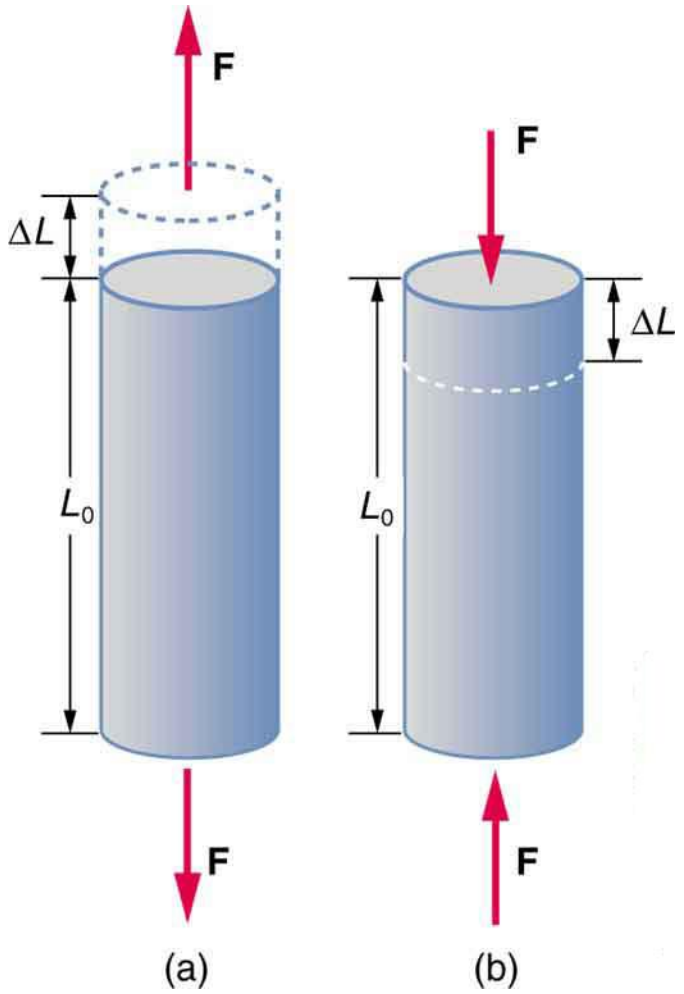
a) Normal stress: In this case force applied on the body is normal (perpendicular) to the surface of the body.

b) Tangential or Shear stress: In this case force applied on the body is tangential (parallel) to the surface of the body.



2(A). Types of Stress

- Normal Stress can be of two types.
  a. Expansive: If the volume of the body is increased on application of the load.
  b. Compressive: If the volume of the body is decreased on application of the load.

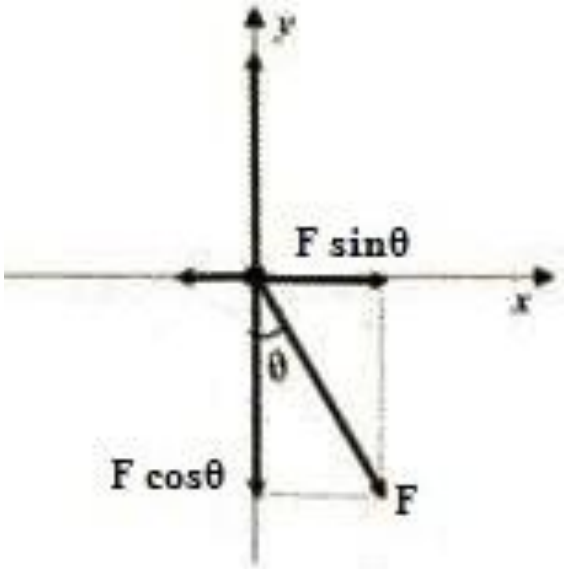


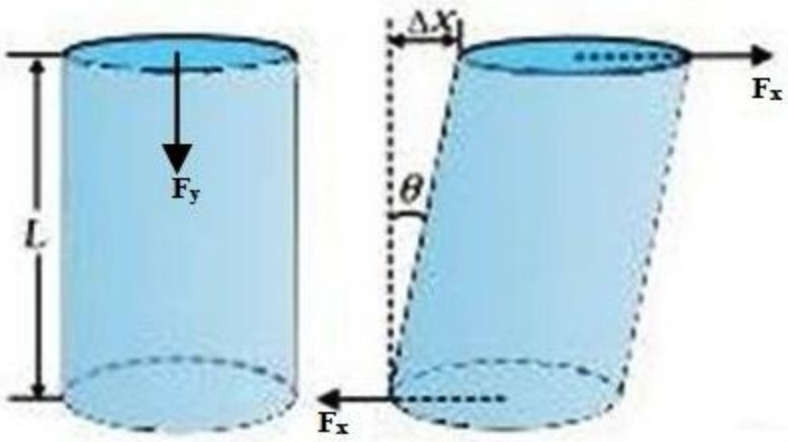
2(A). Types of Stress

* Note: If the force is inclined (neither perpendicular nor parallel) to the surface of the body then,

i. The component of the applied force which is perpendicular to the surface of the body is responsible for the change in dimensions of the body.

ii. The component of the applied force which is parallel to the surface of the body is responsible for the change in shape of the body.





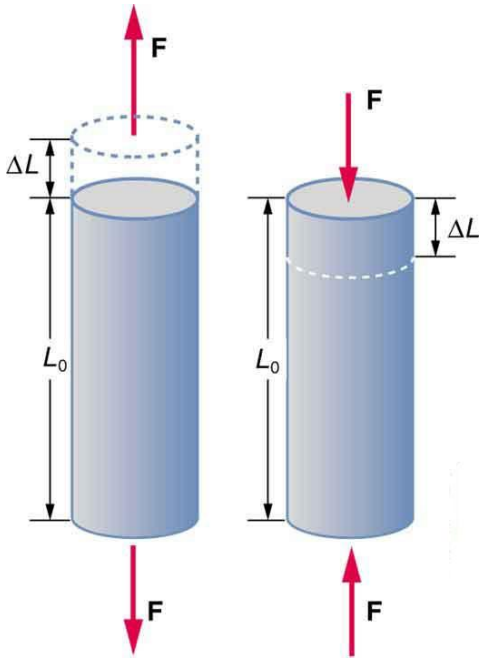
3. Strain

- It is the change produced in the dimensions or shape of the body on application of the load.

$$Linear\ Strain = \frac{\Delta L}{L}$$

$$Volume\ Strain = \frac{\Delta V}{V}$$

$$Shear\ Strain\ (\theta) = \frac{\Delta x}{L}$$

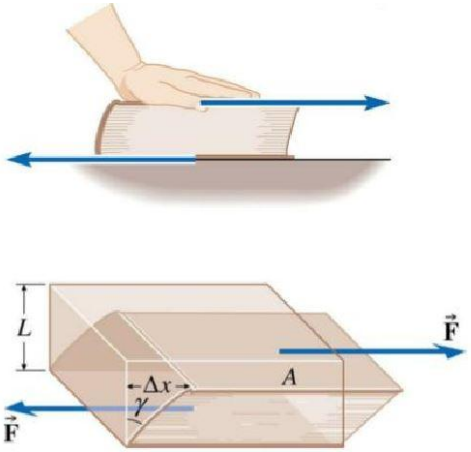


3(A). Type of Strain

a. Linear Strain: Change in length per unit length.

b. Volume Strain: Change in volume per unit volume.

c. Angular deformation(θ)



A **shear deformation** occurs when two forces are applied on opposite surfaces of an object.

Hooke's Law

- When the strain is small, stress is proportional to the strain.

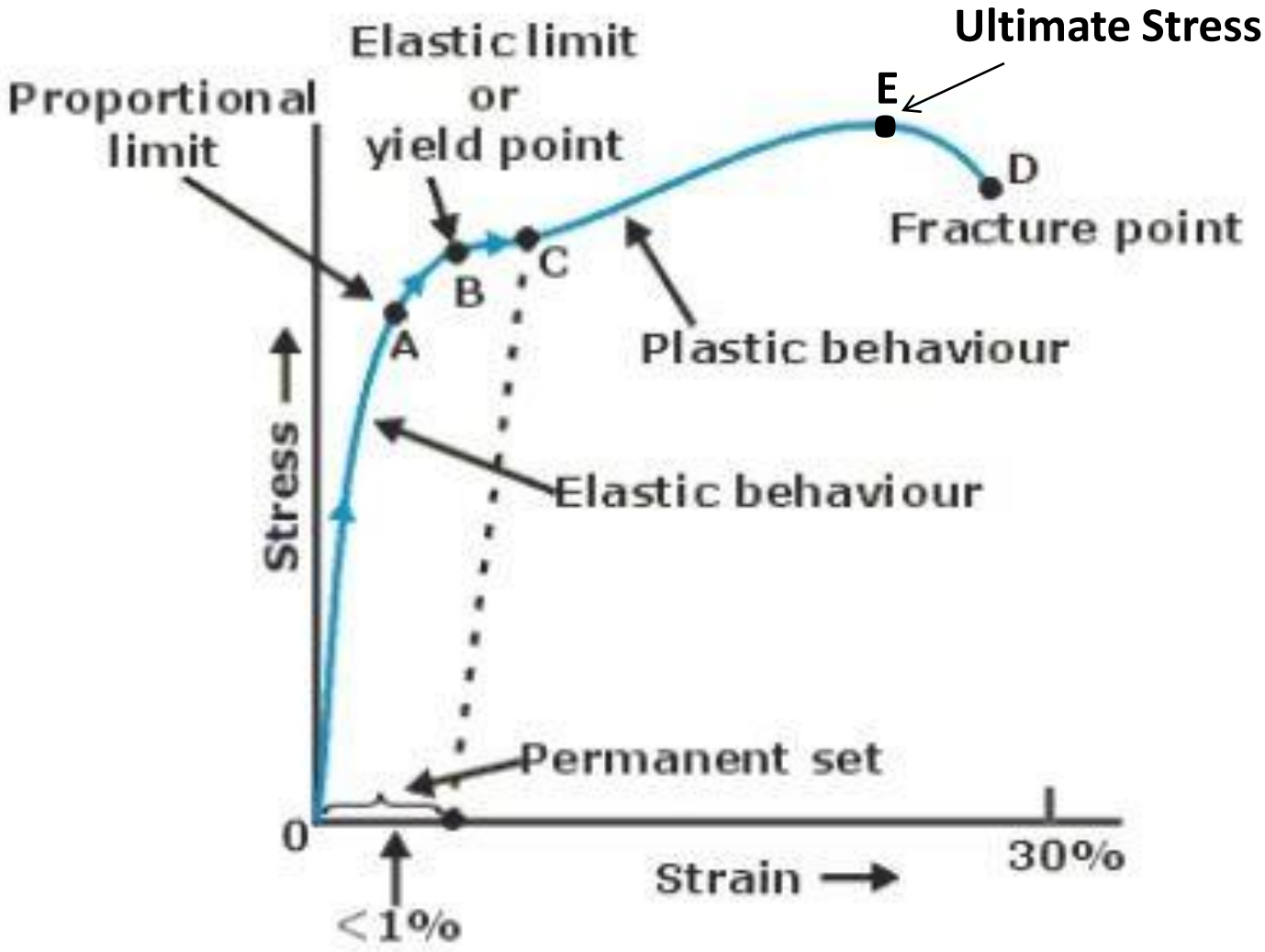
  - Stress $\propto$ Strain

  $\therefore$ Stress = E × Strain $\qquad E = \frac{Stress}{Strain}$

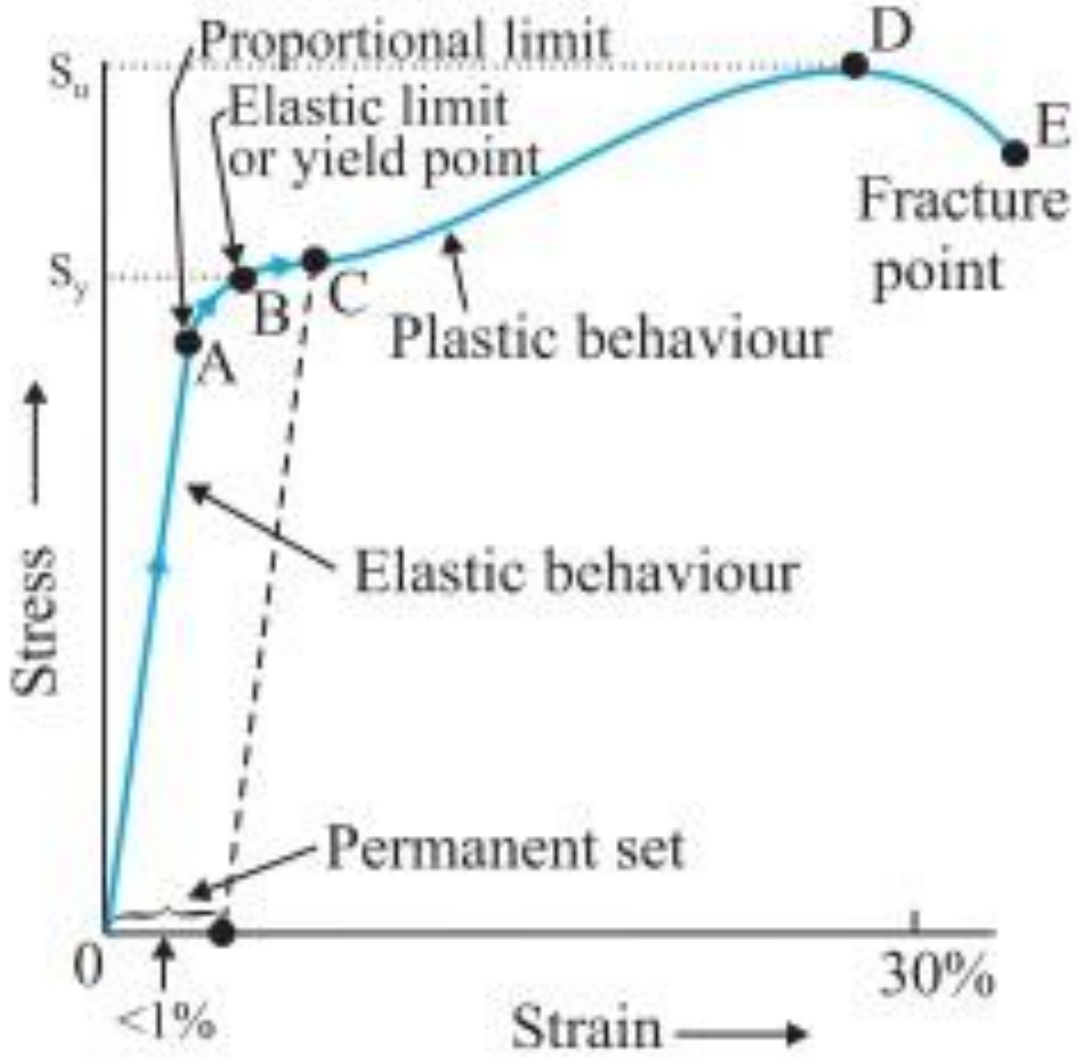
  Here,

  E = Proportionality constant and known as Elastic Modulus (EM)

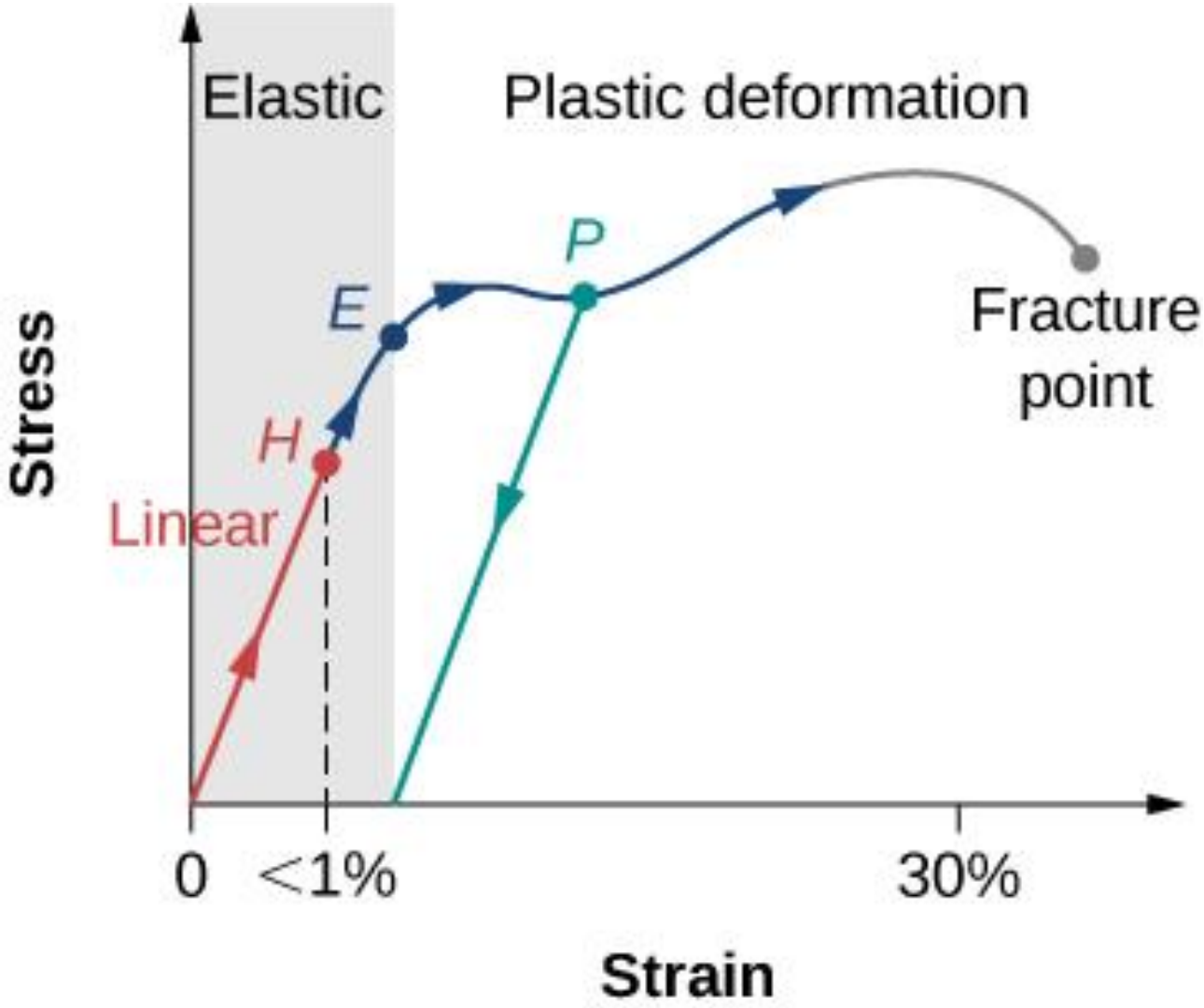
Stress – Strain Curve



Stress – Strain Curve



Stress – Strain Curve



Ductility, Brittleness, Plasticity