UNIT 7

Properties of Bulk Matter

SOME TERMS RELATED TO ELASTICITY

- **Rigid body :** It is that body which does not show any deformation when any external force is applied on it. In fact there is no perfectly rigid body but diamond is the nearest approach to a rigid body.
- **Deforming force :** It is that force which when applied changes the configuration of the body.
- **Elasticity :** It is the property of the body by virtue of which the body regains its original configuration (length, volume or shape) when the deforming forces are removed.
- **Perfectly elastic body :** It is that body which regains its original configuration immediately and completely after the removal of deforming force from it.
- **Perfectly plastic body :** It is that body which does not regain its original configuration at all on the removal of deforming force, howsoever small the deforming force may be.
- In fact no body is either perfectly elastic or perfectly plastic and the behaviour of actual bodies lies between the two extremes.
- Phosphor bronze and quartz are the examples of nearly perfectly elastic bodies. Putty and paraffin wax are the examples of nearly perfectly plastic bodies.
- **Elastic limit :** It is the upper limit of deforming force up to which, if deforming force is removed, the body regains its original form completely and beyond which if deforming force is increased, the body loses its property of elasticity and gets permanently deformed.
- Elastic limit is the property of a body whereas elasticity is the property of material of a body.

STRESS

- When a body is subjected to a deforming force, a restoring force is developed in the body. This restoring force is equal in magnitude but opposite in direction to the applied force. The restoring force per unit area is known as stress. If F is the force applied and A is the area of cross-section of the body, then

$$\text{Stress} = \frac{F}{A}$$

- The unit of stress in SI system is N m^{-2} or pascal (Pa) and in CGS system is dyne cm^{-2}.
- The dimensional formula of stress is same as that of pressure *i.e.* $[ML^{-1}T^{-2}]$.

Types of Stresses

Stresses are of two types :

- Normal stress
- Tangential or shearing stress

- **Normal stress :** When a deforming force acts normally over an area of a body, then the internal restoring force set up per unit area of the body is called as normal stress.
- Normal stress can be subdivided into following categories :
  - **Tensile stress :** If there is an increase in the length or extension of the body in the direction of force applied, the stress set up is called as tensile stress.
  - **Compressive stress :** If there is a decrease in length or compression of the body due to force applied, the stress set up is called as compressive stress.
  - **Hydraulic stress :** When a solid body undergoes a change in volume without any change in its geometrical shape on applying the force perpendicular to every point on the surface of a body, then the restoring force per unit area in the body is called hydraulic stress. Hydraulic stress is generally possible when a solid spherical body is placed in a fluid under high pressure.

    Note : Tensile or compressive stress can also be termed as **longitudinal stress.**
- **Tangential or shearing stress :** When a deforming force, acting tangentially to the surface of a body produces a change in the shape of the body without any change in volume, then the stress set up in the body is called as tangential stress or shearing stress.

STRAIN

- Strain is the ratio of two similar quantities, hence it is a unitless and dimensionless quantity.

$$\text{Strain} = \frac{\text{Change in dimension}}{\text{Original dimension}}$$