

UNIT – 1

PROPERTIES OF MATTER (Elasticity)

Elasticity – Stress-strain diagram and its uses – factors affecting elastic modulus and tensile strength. Torsional stress and deformations – twisting couple – torsion pendulum: theory and experiment – bending of beams. Bending moment – cantilever: theory and experiment. Uniform and non-uniform bending: theory and experiment – I-shaped girders – stress due to bending in beams

Introduction of Elasticity

Elasticity is a branch of physics which deals with the elastic property of materials. When an external force is applied to a body, there will be some change in its length, shape and volume. When the external force is removed, if the body regains its original shape and size, then the body is said to be a perfectly elastic body.

If the body does not regain its original shape (or) size, after the removal of the applied force, then it is said to be a perfectly plastic body. In nature no body is perfectly elastic (or) perfectly plastic.

Therefore elasticity is the property of the body by virtue of which it tends to regain its original shape (or) size after the removal of deforming forces applied externally to it.

1.1. Fundamental definitions

1.1.1. Deforming force

The force which changes or tries to change the shape or size of a body without moving it as a whole is called deforming force.

1.1.2. Elasticity

Elasticity is the properties of solid material to regain their original shape or size after remove the deforming force acting on it.

Example: Rubber, a fiber of quartz crystal.

- Elasticity is the molecular property of matter.
- It is different in different materials.

1.1.3. Plasticity

If the body does not regain its original shape and size, when the applied force is removed, then it is a perfect plastic body. This property is called plasticity.

Example: Putty, Wood, Mud.

1.1.4. Stress

The restoring force acting per unit area inside the body is known as stress.

Stress = restoring force/area

$$= F/A \text{ (Nm}^{-2}\text{)}$$

This restoring force is equal and opposite of the applied force. Therefore, stress is also defined as;

The applied force per unit cross sectional area of the body is called stress.

Types of stress

- Linear (longitudinal)stress
- Shearing (tangential)stress
- Volume (bulk)stress

1.1.5. Strain

Relative change in dimension or shape of a body by the applied force is called strain. Strain is also measured by the ratio of change in dimension to original dimension.

Types of strain

- Linear (longitudinal)strain
- Shearing (tangential)strain
- Volume (bulk)strain

1.1.6.Hooke'sLaw

It states that “*Within the elastic limit, stress in a body is directly proportional to strain produced on it*”