INTRODUCTION

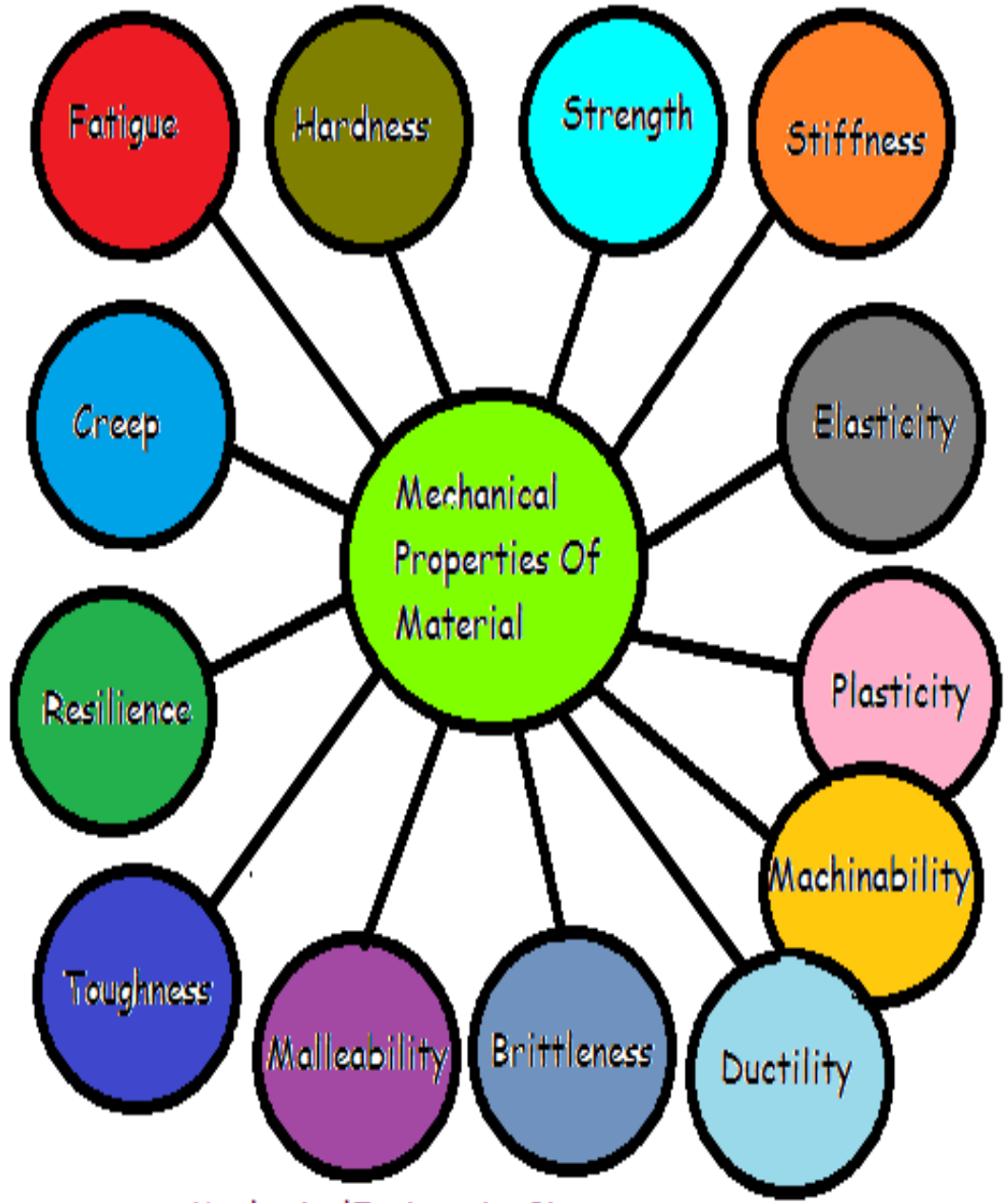
OF

MATERIALS AND ITS PROPERTIES

The physical property of a material denotes the physical states of material that are exclusive of their chemical or mechanical components. In particular, these properties encompass texture, density, mass, melting and boiling points, electrical and thermal conductivity.

Strength Of Materials :

- **Strength of materials**, also called **Mechanics of materials**, is a subject which deals with the behavior of solid objects subject to stresses and strains.
- The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts.



1. **STRENGTH :**

It is the capacity to withstand destruction under the action of external loads. Stronger the material, greater the load it can withstand. Strength in another way determines the ability of a material to withstand stress without failure.

2. **ELASTICITY :**

It is the property of a material for which deformation caused by applied load & disappears upon removal of load. It is the power of a material of returning to its original position after deformation when the load was removed. Elasticity is the tensile property of a material.

Rigid Body:

- A rigid body is defined as a body on which the distance between two points never changes whatever be the force applied on it.
- Practically, there is no rigid body.

Deformable body:

A deformable body is defined as a body on which the distance between two points changes under action of some forces when applied on it.

The study of the property of this body is called **Elasticity**

i) PROPORTIONAL LIMIT :

It is the maximum stress under which a material will maintain a perfectly uniform rate of strain to stress. It is used in important application such as precision instrument, spring etc.

ii) ELASTIC LIMIT :

Most materials can be stressed slightly above the proportional limit without taking a permanent set. The greatest stress that a material can withstand without taking up some permanent set is called elastic limit. Beyond the elastic limit, the material does not return to its original form and a permanent set occurs.

iii) YIELD POINT :

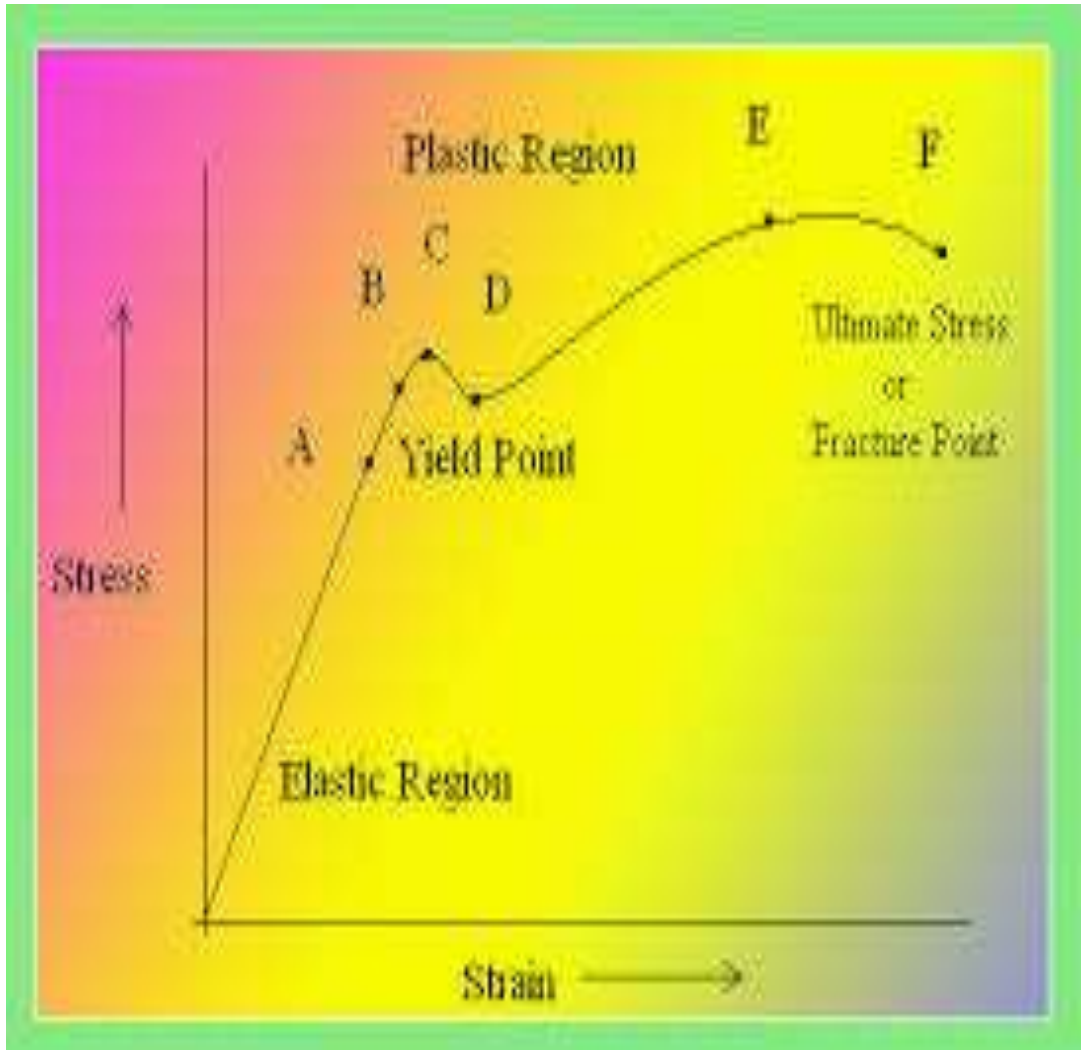
At a certain point ductile materials cease offering resistance to tensile force i.e. they flow and a relative large permanent set takes place without a noticeable increase a load. This point is called yield point. Mild steel is an example of this phenomenon.

iv) PROOF STRESS :

Most ductile materials shown progressive yield and another measure of ill stress, usually known as Proof Stress. It is defined as the amount of stress a material can withstand without taking a small amount of set.

3. STIFFNESS :

The ratio between the resistance of a material to elastic deformation or deflection of that material is called stiffness. A material which caused slight deformation under load has a high degree of stiffness. If a material follows hooke's law i.e. the material has a linear stress-strain relation, its stiffness is measured by young's modulus (E). The higher the value of young's modulus, the material is stiffer.



4. PLASTICITY :

It is the ability to undergo some degree of permanent deformation without failure. Plastic deformation will takes place only after the elastic range has been exceeded. It is important in forming, shaping, extruding and many other hot-cold metal working processes. Materials such as clay, lead etc. are plastic at room temperature and steel is plastic when at bright red. Generally plasticity increases with increasing temperature.

5. DUCTILITY:

It is the property of a material which enables it to draw out into thin wire. Mild steel is a ductile material. The percentage elongation and reduction in area in tension is often used as empirical measures of ductility.

6. MALLEABILITY:

It is the ability to flatten a metal into thin sheets without cracking by hot or cold working. Aluminium, Copper, Lead etc. are malleable material.

7. RESISTANCE:

It is the capacity of a material to absorb energy elastically. On removal of load the energy stored is given off, exactly as in when the load is removed. The maximum energy which can be stored in a body up to elastic limit is called proof resistance.

8. **TOUGHNESS**:

It is measure of the amount of energy of a material that can be absorbed before actual fracture or failure takes place i.e. if a load suddenly applied to a piece of mild steel, it will absorb much more energy before failure occurs. Thus a mild steel is said to be much tougher than a glass.

It can also be defined as it is the ability of a material to withstand both plastic and elastic deformation and it is a desirable quantity for structural and machine parts e.g. Manganese Steel, Wrought Iron, Mild Steel etc.

9. HARDNESS:

It is the fundamental property which is closely related to strength. It is usually defined in terms of ability of a material to resist scratching, abrasion, cutting, penetration. Hardness of a metal does not directly related to hardenability of the metal.

The methods are now in use for determining the hardness of material – Brinell, Rockwell and Vickers.

10. BRITTLENESS:

It is the property of a material of breaking without much permanent distortion. There are many materials which break or fail before much deformation takes place such as glass, cast iron etc.

11. CREEP:

The slow and progressive deformation of a material with time constant stress is called creep. The simplest type of creep is viscous flow. It is most generally defined as time dependent strain occurring under stress. A metal generally shows creep at high temperature where as plastic, rubber and similar materials are very temperature sensitive to creep.

12. MACHINEABILITY:

It is simply started that the ease with which a metal can be removed in various machining operations. Good machineability implies satisfactory result in machining. The machineability is indicated by percentage which is termed as machineability index. The machineability index of carbon, steels are from 40% to 60% and that of cast iron from 50% to 80%.

13. FATIGUE:

It is the property of a material which determines its behaviour when subjected to cyclic load applications within the elastic range of material. Under these conditions, failure may occur to give services indefinitely. In many instances a component is designed to give a certain length of service under a specific cycle of loading.

14. ELASTIC LIMIT:

Whenever some external system of forces acts on a body it undergoes some deformation. If external forces are removed, the body springs back to its original position. The value of stress corresponding to force is called Elastic Limit of material. Beyond elastic limit the material goes into plastic stage.