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CHAPTER 16
PHYSICS OF SOLIDS

* Elastic Modulus = $\frac{\text{Stress}}{\text{Strain}}$

* Young's Modulus:

$$Y = \frac{FL}{A\Delta L}$$

* Shear or Rigidity Modulus:

$$S = \frac{F}{A\theta}$$

* Bulk Modulus

$$B = \frac{F/A}{(-\Delta V/V)} = \frac{FV}{A(\Delta V)}$$

or $$B = \frac{\Delta P}{(-\Delta V/V)}$$

* Stress = k x strain Hooke's Law

* Strain Energy

$$U = \frac{1}{2} Fe$$

* Strain energy per unit volume

$$u = \frac{1}{2} (\text{stress} \times \text{strain})$$

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* $B = H \times \mu_0$

  H: Magnetic Field Strength

  B: Magnetic Flux Density

* $Y = \frac{4FL}{\pi d^2 \Delta L}$

* Relation between ΔL and r^2

  $\Delta L \propto \frac{L}{r^2}$ (For same Force and same Y)

* Strain Energy per unit volume

  $u = \frac{1}{2} \times Y \times (\text{strain})^2$

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MAGNETIC HYSTERESIS

The phenomenon of lagging of flux density (B) behind the magnetizing force (H) in a magnetic material subjected to a cycle of magnetization is known as magnetic hysteresis.

SATURATION:

Saturation occurs when on increasing the current the dipole moment or the molecules of the magnetic material align itself in one direction.

RETENTIVITY:

It is a material's ability to retain a certain amount of residual magnetic field when the magnetizing force is removed after achieving saturation.

* Hooke's law is a relation between stress and strain.

* YIELD POINT:

The stress beyond which a material becomes plastic.

Yield Point → Elastic Limit

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* MAXIMUM TENSILE STRENGTH:

The maximum stress that given material can withstand under an applied force

* Stiff material is characterized by high Young's Modulus.

* CRITICAL TEMPERATURE:

The temperature at which and below which a material becomes a super conductor is said to be its critical temperature.

* CURIE TEMPERATURE:

The temperature at which ferromagnetic material becomes paramagnetic

* SHEAR MODULUS

$$S = \frac{F}{A\theta}$$

The concept of shear modulus applies only to solids. The reason is that shear forces are required to deform a solid and the solid tends to return to its original shape when the shear forces are removed.

Shear Modulus doesnot apply to liquid and gases bcz they donot have definite shape to return to after deformation

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* YOUNG'S MODULUS:

characteristic property of solid materials only

* BULK MODULUS:

Bulk Modulus is maximum for solids and minimum for gases

* Coercivity:

To demagnetize the material, the magnetizing current is reversed and increased to reduce the magnetization to zero, this is known as coercive current.

→ The coercivity of steel is more than iron, so it requires more current to demagnetize

* AREA OF HYSTERESIS LOOP:

The area of hysteresis loop is a measure of the energy needed to magnetize and demagnetize the specimen during each cycle. This is the energy required to do work against internal friction of domains. This work is done against friction, is dissipated as heat. It is called hysteresis loss.

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* Glass is more elastic than rubber
Water is more elastic than air

* Reciprocal of bulk modulus is called compressibility

* Typical thermal excitation = kT = 0.025eV

* All semiconductors are insulators at very low temperatures.

* The concentration of charge carriers in a typical semiconductor at room temperature is about $10^{21}\ m^{-3}$. The concentration of charge carrier in a metal is about ten million times greater.

* SUPER CONDUCTOR:
A superconductor is a material that can conduct electricity or transport electrons from one atom to another with no resistance.

Critical Temp: The temp at which material becomes superconductive

* Paramagnetic: Aluminium, Antimony

Diamagnetic: Copper, Zinc, Bismuth

Ferromagnetic: Iron, Nickel, Cobalt