Sub - SM   3rd sem Diploma   Structural Mechanics

(1)(a) Resistance to deformation per unit cross sectional area is called stress.

(b) It is the ratio of change in length to their orginal length. It describes relative deformation or change in shape and size of body under applied forces.

(c) The Number of forces acting either left or right part of the section is called shear force.

(d) The algebraic sum of all the moments acting either left or right part of the section is called bending moment.

(2) (a) **Tensile stress**:- When the resistance offered by a section of a member is against an increase in length, the section is said to a tensile stress.

Compressive stress:- It is the ratio of compressive force per unit cross sectional area. or when the resistance offered by a section of a member is against the decrease in length is called compressive stress.

Shear stress:- force tending to cause deformation of a material by slippage along a plane or plane parralel to the imposed stress.

(b) **Centre of gravity**:- The centre of gravity is an imaginary point in the body where the total weight of the body supposed to be act.

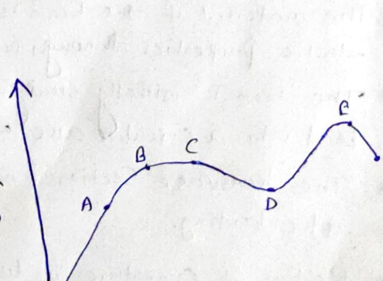
Moment of Inertia:- It is defined as the quantity expressed by the body resisting angular acceleration which is the sum of product of mass of every particle with its square distance from the axis of rotation.

(c) **Condition of equilibrium**:- There are two condition of equilibrium

(1) The sum or resultant of all external forces acting on the body must be equal to Zero.

(2) The sum or resultant of all external torques from external forces acting on the object must be Zero.

(3) (a) **Stress - strain diagram** of an elastic body



* Stress-strain diagram obtained for a mild steel specimen subjected to a tensile test.

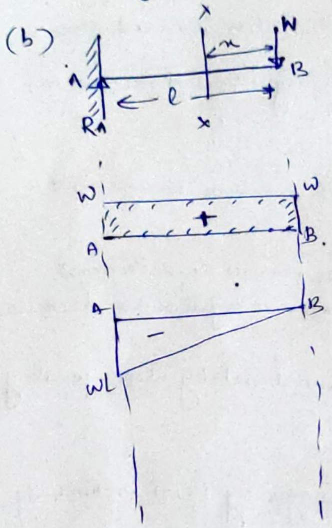
* The plot from point O to A is a straight line strain. The stress corresponding to the point A is called limit of propotionality. Here Hooke's law is applicable i.e stress is directly propotional to strain.

* If the specimen is extended beyond the limit of propotionality, upto B, the material still remain elastic. But in the range A to B the relation betn stress vs strain is not linear. The stress at point B is called elastic limit.

* If the material extended beyond the elastic limit, plastic deformation takes place. In the range B to C the strain increases with almost constant stress. The stress at C is called upper yield point.

* at the Condition D the material again offers resistance to greater extension. The stress at D is called the Lower yield point.
* As load increases, extension increases and at E, necking is formed. The stress at E is called ultimate tensile stress.
* Finally at point F failure of material will occurs.

(b)



Calculation of Reaction

$R_A = W$.

Figure shows a cantilever of AB of length "l" fixed at A and free at B carrying load W at its free end.

Consider a Section X−X at a distance x from free end.

Calculation of shear force

S.f at X−X = $S_x = +W$

at $x = 0$, $S_B = +W$

at $x = L$, $S_A = +W$.

Hence S.f is constant at all section.

Calculation of Bending moment

B.M at X−X = $M_x = -Wx$

at $x = 0$, $M_B = 0$

at $x = L$, $M_A = -WL$

(c) Bending stress in beam

* When some external force acts on a beam, the shear force and Bending moments are set up at all sections of the beam.
* Due to S.F and B.M, the beam undergoes deformation. The material of the beam offers resistance to deformation.
* Stresses introduced by bending moment are known as bending stress.

Assumption of Pure bending

* The material of the beam is isotropic & homogeneous. i.e Same density and elastic Properties through out.
* The beam is initially straight and unstressed and all the longitudinal filaments bend into a circular arc with a common Centre of curvature.
* The transverse Sections which were plane before bending remain plane after bending.
* Radius of Curvature is large compared to the dimenssions of the C/s of the beam.
* There is no resultant force Perpendicular to any C/s
* All the layers of the beam are free to elongate & contract, independently of the layer, above or below it.
* The elastic limit is nowhere exceeded during bending.
* Young's modulus for the material is the Same in tension and Compression.