KCG COLLEGE OF TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

CE 6306-STRENGTH OF MATERIALS (SEM: 3)

QUESTION BANK FOR UNIT 1

PART-A (2 Marks)

1. ***Define Hooke's Law***
   It states that when a material is loaded, with in its elastic limit, the stress is directly proportional to the strain.
   Stress α strain
   $\sigma \alpha e$, $\sigma = E e$, where E- young's modulus, σ- stress, e- strain
2. ***Define : Resilience.***
   Resilience: The total strain energy stored in the body is generally known as resilience.

3. ***Define proof resilience.***
   Proof resilience: The maximum strain energy that can be stored in a material within its elastic limit is known as proof resilience.

4. ***Define modulus of resilience***
   Modulus of resilience: It is the proof resilience of the material per unit volume.

   $$\text{Modulus of resilience} = \frac{\text{Proof resilience}}{\text{Volume of the body}}$$
5. ***Define elasticity***
   The ability of the material to resume its original shape after the removal of its external force.
6. ***Give relationship between bulk modulus and young's modulus.***
   E = 3k [1-2/m]
   E- Young's modulus
   k- Bulk modulus
   1/m – Poisson's ratio

7. ***Define Poisson's ratio***
   When a body is stressed within its elastic limit, the ratio of lateral strain to the longitudinal strain is constant for a given material.
8. ***Define Elastic Limit.***
   Whenever some external force acts on a body it undergoes some deformation and if the external force is removed then it springs back to its original position. This is known as elasticity.
9. ***Define shear stress and shear strain***
   The two equal and opposite force act tangentially on any cross sectional plane of a body tending to slide one part of the body over the other parts. The stress induced in that section is called shear stress and the corresponding strain is known as shear strain.
10. ***Define volumetric strain***
    Volumetric strain is defined as the ratio of change in volume to the original volume of the body.
11. ***Define thermal stress***

When the material is subjected to a change in temperature, then a stress will be induced in the material such stress is known as temperature or thermal stress.

12. Write any four types of beams

i) Cantilever beam
ii) Simply supported beams
iii) Overhanging beams
iv) Continuous beam

13. What is the use of Mohr's circle?

Mohr's circle is a geometric representation of the 2-D transformation of stresses and is very useful to perform quick and efficient estimations, checks of more extensive work, and other such uses.

14. Define Bulk modulus.

When a body is stressed, within its elastic limit, the ratio of direct stress to the corresponding volumetric stress is constant. This is known as bulk modulus.

15. Define factor of safety.

It is defined as the ratio of ultimate stress to the permissible stress.

16. What is compound bar?

A bar of two or more different materials, joined together is called a compound bar.

17. Define principal planes and principal stresses.

Principal stresses may be defined as the extreme values of the normal stresses possible in the material. These are the maximum normal stress and the minimum normal stress. Maximum normal stress is called major principal stress while minimum normal stress is called minor principal stress. Principal plane may be defined as the plane on which normal stress attains its maximum and minimum value.

18. Define longitudinal strain.

When a body is subjected to an axial tensile or compressive load, there is an axial deformation to the original length of the body is known as longitudinal strain.

19. ***Define lateral strain***.

The strain at the right angles to the direction of applied load is known as lateral strain.

20. Define strain energy.

Whenever a body is strained, the energy is absorbed in the body. The energy which is absorbed in the body due to straining effect is known as strain energy.

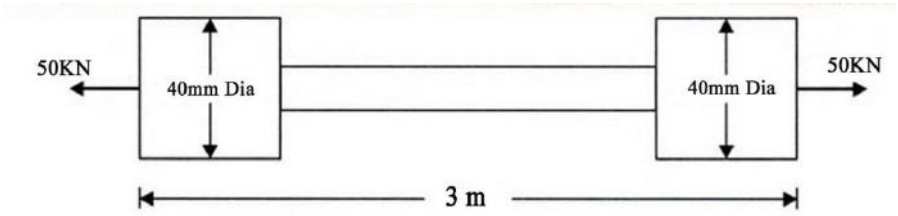
PART-B (16 Marks)

1. A solid bar of diameter 20 mm when subjected to an axial tensile load of 40KN, the reduction in diameter of the rod was observed as 6.4 x10^{-3} mm. The bulk modulus of the material of the bar is 67 GPa. Determine
   i) Young's modulus
   ii) Poisson's ratio
   iii) Modulus of rigidity
   iv) Change in length per meter and
   v) Change in volume of bar per meter length.

2. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly joined at each end. If, at a temperature of 10^0 C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200^0

C. take E for steel and copper as 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The value of coefficient of linear expansion for steel and copper is given as 11×10^{-6} per^0 C and 18×10^{-6} per^0 C respectively.

3. The bar shown in below figure is subjected to a tensile load of 50 KN. If the stress in the middle portion is limited to 150 MPa, then what should be its diameter? Find also the length of middle portion if the total elongation the bar should not exceed by 3 mm. Take E= 100 Gpa.



4. The extension in a rectangular steel bar of length 400mm and thickness 3mm is found be 0.21mm .The bar tapers uniformly in width from 20mm to 60mm E for the bar is 2x 105 N/mm2.Determine the axial load on the bar.
5. The normal stresses at a point on two mutual perpendicular planes are 140Mpa (tensile) and 100Mpa (compressive). Determine the shear stress on these planes if the maximum stress is limited to 150Mpa(tensile) determine also the following using Mohr's circle.
   i) Minimum principal stress
   ii) Maximum shear stress and its plane
   iii) Normal, shear and resultant stresses on a plane which is inclined at 30^0 anticlockwise to x plane.

6. At a point in a strained material the principal stresses are 100 N/mm^2 (tensile) and 60 N/mm^2 (compressive). Determine normal stress, shear stress, resultant stress on a plane inclined at 50 degrees to the axis of the major principal stress. Also determine the maximum shear stress at the point.