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AZIS, Haldighati,
Guwahati-781017

B.Tech. 3rd Semester End-Term Examination

SOLID MECHANICS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Choose the correct answer for the following multiple choice questions :

(10 × 1 = 10)

(i) Poisson's ratio, μ is equal to

- (a) Lateral stress per longitudinal strain
- (b) Longitudinal stress per lateral strain
- (c) Lateral strain per longitudinal strain
- (d) Longitudinal strain per lateral strain

(ii) Hooke's law holds good up to

- (a) Elastic limit
- (b) Yield point
- (c) Plastic limit
- (d) Fracture point

(iii) The extension of a circular bar tapering uniformly from diameter d_1 at one end to diameter d_2 at the other end, and subjected to an axial pull of P is given by

- (a) $\delta l = 4 PE / \pi L d^2$
- (b) $\delta l = 4 PL / \pi E d_1 d_2$
- (c) $\delta l = 4 PLE / \pi d_1 d_2$
- (d) None of these

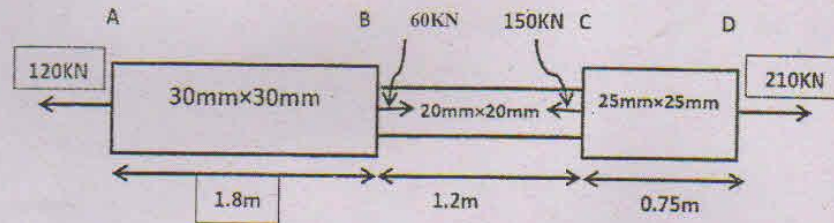
(iv) Principal stress is which have

- (a) No deformation
- (b) No shear stress
- (c) No direct stress
- (d) None of the above

[Turn over

- (v) When a member is subjected to like direct stresses in two mutually perpendicular direction, then?
- (a) $\sigma_n = [(\sigma_x + \sigma_y)/2] / [(\sigma_x - \sigma_y) \cos 2\theta/2]$
- (b) $\sigma_n = (\sigma_x - \sigma_y) \cos 2\theta/2$
- (c) $\sigma_x = [(\sigma_x + \sigma_y)/2] + [(\sigma_x - \sigma_y) \cos 2\theta/2]$
- (d) $\sigma_x = [(\sigma_x + \sigma_y) \cos 2\theta/2]$
- (vi) Section modulus for a hollow rectangular section with outer dimension $B \times D$ and inner dimension $b \times d$ is :
- (a) $(BD^3 - bd^3)/12$ (b) $(BD^3 - bd^3)/12D$
- (c) $(BD^3 - bd^3)/6$ (d) $(BD^3 - bd^3)/6D$
- (vii) Slenderness ratio is
- (a) Actual moment of inertia per unit length of the column
- (b) Equal to actual length of the column
- (c) Actual length of the column per least radius of gyration
- (d) Equal to the least radius of gyration of the column
- (viii) Beam columns are the columns which are subjected to
- (a) Compressive loads
- (b) Transverse loads
- (c) Both compressive and transverse loads
- (d) Both (b) and (c)
- (ix) Maximum shear stress at any point in a thin cylinder of thickness t , diameter d and subjected to internal fluid pressure p is equal to
- (a) $p \times d \times 8t$ (b) $p/(d \times 8t)$
- (c) $8t/(d \times p)$ (d) $(p \times d)/8t$
- (x) Two types of rivet joint are
- (a) Lap joint and weld joint
- (b) Weld joint and butt joint
- (c) Lap joint and butt joint
- (d) None

2. (a) What do you mean by thermal stress and thermal strain in a body? (2)
- (b) Find out the total change in length of a bar with varying sections consisting of different materials. (7)
- (c) A member ABCD is subjected to loading system as shown in figure. Determine the net change of the length. Take $E = 2 \times 10^5 \text{ N/mm}^2$. (6)



3. (a) Explain the Mohr's circle of stress. (5)
- (b) At a point in an elastic material, a direct tensile stress of 65 kN/mm^2 and a direct compressive stress of 45 kN/mm^2 are applied on planes at right angles to each other. If the maximum principal stresses are limited to 78 N/mm^2 (tensile), find the shear stress that may be allowed on the planes. Also determine the minimum principal stress and maximum shear stress. (10)
4. (a) What do you mean by pure bending of a beam? Explain the theory of simple bending with assumptions. (2 + 5)
- (b) Three beams have same length, same allowable bending stress and same maximum bending moment. The cross sections are-a circle, a square and a rectangle with depth twice the width. Find the ratio of weights of circular and rectangular beams with respect to the square beam. (8)
5. (a) What is crippling load in a column? (1)
- (b) What are the different end conditions of columns? Find the equivalent lengths for each condition. (2 + 6)
- (c) A column of 4cm internal diameter and 6cm external diameter, 3 m long, failed at compressive load of 10 kN. Find the Rankine's constant if $f_c = 3.2 \text{ kN/cm}^2$ and both ends of the column is fixed. (6)
6. (a) What do you mean by wire winding of thin cylinder? Explain the effect of wire winding in stress distribution in a thin cylinder due internal pressure. (2 + 3)

(b) For a double riveted lap joint is made in two ways : (10)

(i) Rivet dia = 2 cm, pitch = 6 cm, plate thickness = 1.2 cm.

(ii) Rivet dia = 3 cm, pitch = 7 cm, plate thickness = 1.4 cm.

If tensile stress is 125 N/mm^2 , crushing stress is 155 N/mm^2 and shear stress is 90 N/mm^2 , find out the joint with higher efficiency.

7. (a) Find the polar moment of inertia for

(i) A solid shaft of diameter 30 cm.

(ii) For a hollow shaft of internal diameter 22 cm and external diameter 25 cm. (5)

(b) Find out the expression for maximum torque transmitted by a solid circular shaft. (10)