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**Paper Code : CE(ES)402 Introduction to Solid Mechanics**

**UPID : 004444**

*Time Allotted : 3 Hours* *Full Marks :70*

*The Figures in the margin indicate full marks.*

*Candidate are required to give their answers in their own words as far as practicable*

## Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [ 1 x 10 = 10 ]

(i) Principal planes are those planes on which normal stress is_____

(ii) Oil tanks, steam boilers, gas pipes are examples of _____

(iii) Twisting moment is a product of _____ and the radius.

(iv) A built up rolled steel section carrying compressive force is called _____

(v) The Point of contraflexure occurs in case of _____

(vi) In the case of triangular section, the share stress is maximum at the _____

(vii) For _____ columns, the slenderness ratio is more than 32 and less than 120.

(viii) Plane trusses are also known as _____

(ix) Horizontal diameter of Mohr's circle is _____

(x) The ratio of hoop stress to maximum shear stress is _____

(xi) Mention the stress which comes when there is an eccentric load applied.

(xii) In a cantilever carrying a uniformly varying load starting from zero at the free end, the shear force diagram _____

## Group-B (Short Answer Type Question)

Answer any three of the following : [ 5 x 3 = 15 ]

2. State Hooke's Law [5]

3. The steel plate is bent into a circular path of radius 10 m. If the plate section be 120 mm wide and 20 mm thick, then calculate the maximum bending stress. [Consider Young's modulus = 200000 N/mm2]. [5]

4. a. A round Steel rod of 100 mm diameter is bent into an arc of radius 100m. What is the maximum stress in the rod? Take E = 2×105 N/mm2. [5]
   b. Is simple bending and pure bending same?

5. a. Explain how is a joint selected when method of joints is used to analyse a frame? [5]
   b. State the assumptions made in finding out the forces in a perfect frame.
   c. Mention the appropriate method for analysis of plane truss.

6. A beam of uniform rectangular section 200 mm wide and 300 mm deep is simply supported at its ends. It carries a uniformly distributed load of 9 KN/m run over the entire span of 5 m. if the value of E for the beam material is 1 X 104 N/mm2 , find the slope at the supports and maximum deflection. [5]

## Group-C (Long Answer Type Question)

Answer any three of the following : [ 15 x 3 = 45 ]

7. Derive the bending equation based on theory of pure bending. [ 15 ]

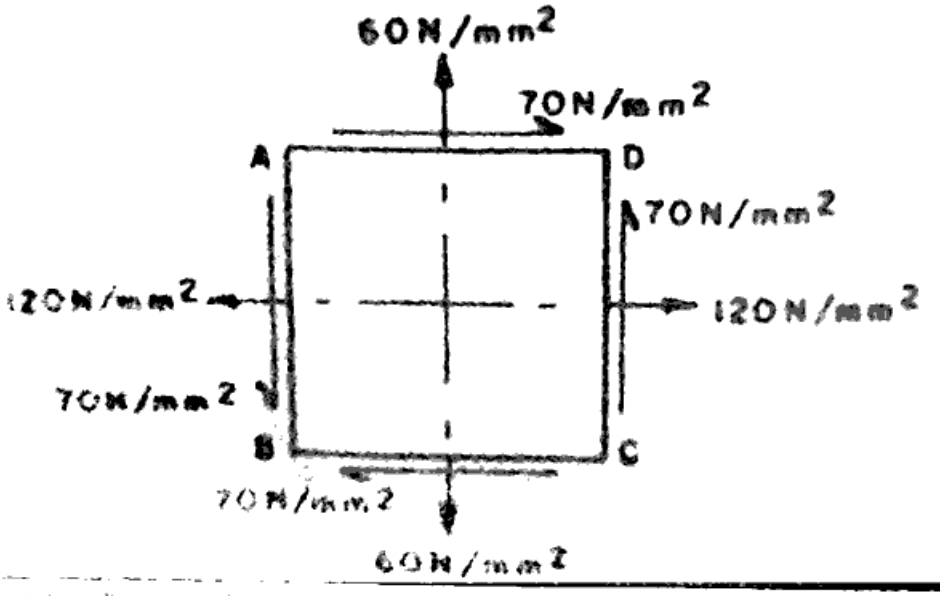
8. (a) A cantilever beam of 3 m length carries three point loads of 15 kN each at distances 1 m, 2 m, and 3 m from fixed end. Calculate the maximum slope and maximum deflection in terms of flexural rigidity. [ 7 ]

   (b) A cantilever of length 2 m carries a uniformly distributed load of 2500 N/m on its full length and a point load of 1000 N at the free end. If the section is rectangular 120 mm wide and 240 mm deep, find the deflection and slope at the free end. Take E = 10,000 N/mm2 [ 8 ]

9. (a) A beam of of size 25 mm x 25 mm is capable of carrying the maximum central load of 2500 N on a simply supported span of 600 mm. The beam of same material but of size 25 mm x 100 mm is used as cantilever of span 1500 mm. Determine the max. value of point load W that can be placed at the free end of this cantilever. [ 12 ]

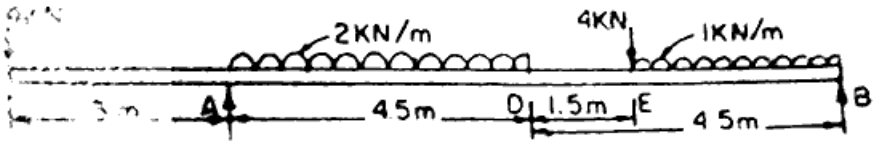
   (b) Define pure bending. [ 3 ]

10. (a) A rectangular element in a strained material is subjected to tensile stresses of 120 N/mm2 and 60 N/mm2 on mutually perpendicular planes together with a share stress of 70 N/mm2. Find the principal stresses, principal planes and maximum share stress in the block. Also find the plane of maximum share stress. [ 10 ]




(b) At a point in a two-dimensional stress system, the normal stresses on two mutually perpendicular planes are f and f' (both alike) with a shear stress equal to s. Show that one of the principal stresses is zero if $s^2 = f.f'$ [ 5 ]

11. (a) Draw the share force and bending moment diagrams for the beams shown attached. Indicate on the diagram the value of shear force and bending moment at significant points. Shown the location and magnitude of maximum bending moment and locate the point of contraflexure. [ 13 ]




(b) Explain point of contraflexure of a beam. [ 2 ]

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