



Name :
Roll No. :
Invigilator's Signature :

CS/B.Arch/SEM-2/ARCH-202/2013

2013

STRENGTH OF MATERIALS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

i) Total elongation produced in a bar due to its self weight is given by

- a) $9.81 \rho l^2 / E$
- b) $9.81 \rho l^2 / 2E$
- c) $9.81 \rho l / E$
- d) $9.81 \rho^2 l / 2E$

ii) The elongation of a circular tapered rod is given by

- a) $4 pl / \pi E d_1 d_2$
- b) $2 pl / \pi E d_1 d_2$
- c) $2 pl / \pi E d_1^2 d_2$
- d) $4 pl / \pi E d_1^2 d_2$

where, p = axial pull and d_1, d_2 = diameters at the two ends.

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viii) The ratio between buckling load and safe load is known as

- a) slenderness ratio b) buckling factor
- c) factor of safety d) none of these.

ix) The secant formula is used for

- a) long columns under eccentric loading
- b) long columns under axial loading
- c) short columns under axial loading
- d) short columns under eccentric loading.

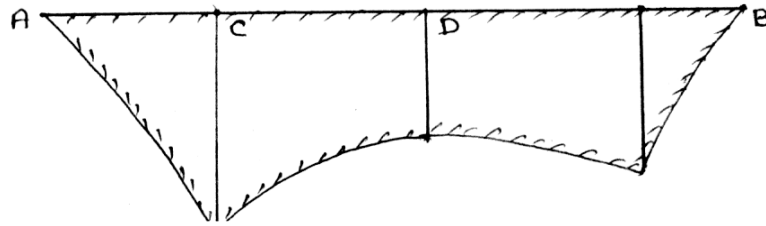
x) Circular beams of uniform strength can be made by varying diameter in such that

- a) $M / Z = C$ b) $\sigma / y = C$
- c) $E / R = C$ d) $M / R = C$

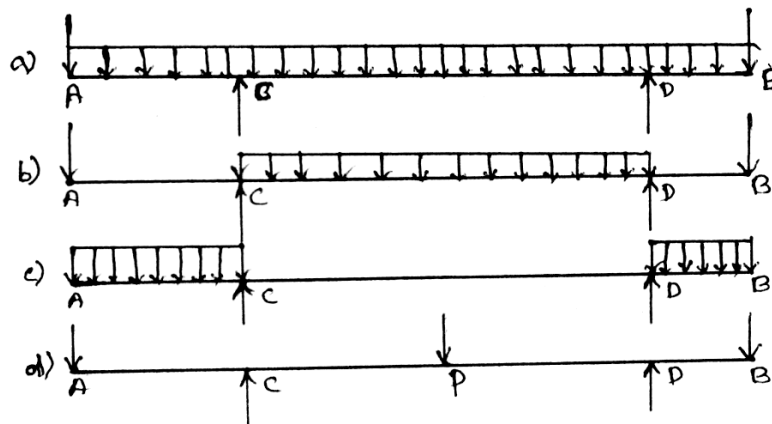
where $C = \text{constant}$.

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- xi) The figure given below shows a BM diagram for the beam *ABCD*



The load diagram for the above beam will be



- xii) Thermal stress developed in the bar depends upon which of the following ?

- a) Coefficient of linear expansion
- b) Change of temperature
- c) Young's modulus
- d) All of these.



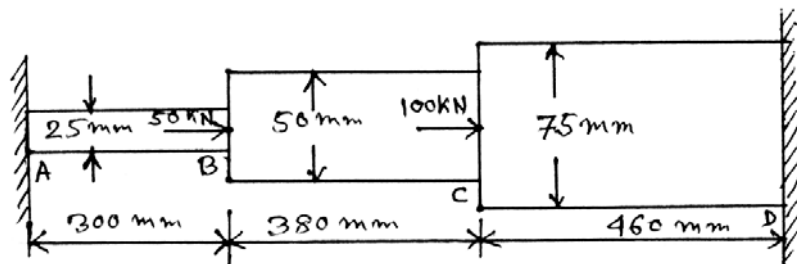
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GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. If the tension test bar is found to taper from $(D + a)$ cm diameter to $(D - a)$ cm diameter, prove that the error involved in using the mean diameter to calculate Young's modulus is $(10a / D)^2$ per cent.
3. Derive a relation for the Euler's crippling load for a column when it has one end fixed and other end hinged.
4. A circular steel bar $ABCD$ rigidly fixed at A and D is subjected to axial load of 50 kN and 100 kN at B and C as shown in the figure :



Find the load sheared by each part of the bar, and the displacements of the points B and C . Take E for the steel as 207 kN/mm^2 .

5. Prove the relation $M / I = \sigma / y = E / R$, where, M = Bending moment, y = Distance of the fibre from neutral axis, I = Moment of inertia, E = Young's modulus of beam, σ = Bending stress, R = Radius of curvature.
6. Prove the relation $M = EI d^2y / dx^2$, where M = Bending moment, E = Young's modulus, I = Moment of Inertia.



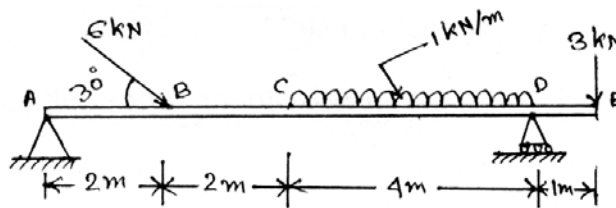
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GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Draw the shear force and bending moment diagrams for the beam as shown in figure below. Also draw axial force diagram.



- b) What is the point of contraflexure ? Locate the point of contraflexure, if any, of the above problem. $10 + 5$
8. a) A steel rod 20 mm in diameter passes centrally through a steel tube of 25 mm internal diameter and 30 mm external diameter. The tube is 800 mm long and is closed by a rigid washer of negligible thickness which is fastened by nuts and threaded on the rod. The nuts are tightened until the compression on the tube is 20 kN. Calculate stress in the tube and the rod. Find the increase in these stresses when one nut tightened by one-quarter of a turn is relative to the other. There are four threads per 10 mm. Take $E = 2 \times 10^5 \text{ N/mm}^2$.



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- b) A reinforced concrete column 500 mm × 500 mm in section is reinforced with four steel bars of 10 mm diameter, one in each corner. The column is carrying a load of 2 MN. Find the stresses in the concrete and steel bars. Take E for steel as $2.1 \times 10^5 \text{ N/mm}^2$ and E for concrete as $1.4 \times 10^4 \text{ N/mm}^2$. 10 + 5
9. a) Explain the assumptions made in the Euler's columns theory.
- b) A timber beam of rectangular section is supported with a load of 20 kN uniformly distributed over a span of 3.6 m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed 7 N/mm^2 , find the dimensions of the cross-section.
- How would you modify the cross-section of the beam, if it carries a concentrated load of 20 kN placed at the centre with the same ratio of breadth to depth ? 5 + 10
10. a) A beam of uniform rectangular section 200 mm wide and 300 mm depth is simply supported at its ends. It carries a UDL of 9 kN/m run over the entire span of 5 m. If the value of E for the beam material is $1 \times 10^4 \text{ N/mm}^2$, find (i) the slope at the supported end, (ii) maximum deflection.
- b) Write the difference between column and strut. What is the slenderness ratio ? What is safe load ?



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11. a) A cantilever beam of length 2 m carries a UDL 2 kN/m over a length of 1 m from the free end, and a point load of 1 kN at the free end. Find the slope and deflection at the free end if $E = 2.1 \times 10^5 \text{ N/mm}^2$ and $I = 6.667 \times 10^7 \text{ mm}^2$.
- b) Write the difference between short column and long column. State the limitations of Euler's formula. 10 + 5

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