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INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – APRIL / MAY 2017

SUBJECT: STRENGTH OF MATERIALS (CE 241)

(BRANCH: Arch/BM/Chem/Civil)

Thursday, 11 May 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A. Explain the terms i) Elastic limit ii) Bulk modulus iii) Shear modulus iv) Nominal breaking stress.

1B. A specimen of steel 30 mm in diameter with a gauge length of 250 mm is tested to destruction. It has an extension of 0.18 mm under a load of 100 kN and the load at elastic limit is 180 kN. The maximum load is 200 kN. The total extension at fracture is 58 mm and diameter at the neck is 20 mm. Find
i) The stress at elastic limit ii) Young's modulus iii) Percentage elongation
iv) Percentage reduction in area iv) Ultimate tensile stress

1C. Derive an expression for the total extension produced by self-weight of a uniform bar, when the bar is suspended vertically.

(4+10+6)

2A. A bar of steel is 50 mm x 50 mm in section and is 150 mm long. It is subjected to a tensile load of 250 kN along the longitudinal axis and tensile loads of 500 kN and 400 kN on the lateral faces. Find the change in the dimensions of the bar and the change in volume. Take E = 2×10^5 N/mm^2 and $\mu = 0.3$.

2B. A load of 500 kN is applied on a short concrete column 250 mm x 250 mm. The column is reinforced with steel bars of total area 2512 mm^2. If the modulus of elasticity for steel is 18 times that of concrete, find the stresses in concrete and steel.
If the stress in concrete shall not exceed 4 N/mm^2, find the area of steel required so that the column may support a load of 600 kN.

(10+10)

3A. Draw SFD and BMD for the beam loaded as shown in **figure 3A**. Locate the points of contraflexure. Also find the magnitude and location of maximum bending moment.

3B. A square beam 25 mm x 25 mm in section and 2 m long is simply supported at the ends. The beam fails when a point load of 500 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40 mm wide, 60 mm deep and 1 m long?

(12 + 8)

4A. Prove that the ratio of maximum shear stress to mean shear stress is 1.5 for a beam of isosceles triangular cross -section. Plot the stress variation across the cross-section.

4B. An I section beam 350 mm x 150 mm has a web thickness of 10 mm and a flange thickness of 20 mm. **(Figure 4B)**. If the shear force on the section is 40 kN, find the maximum shear stress developed in the section and sketch the shear stress distributed across the section.

(10 + 10)

5A. Derive pure bending equation with the help of a neat diagram and list the assumptions made in pure bending theory.

5B. The state of the stress in a two-dimensional stressed body is shown in **figure 5B**. Determine the principal stresses, principal planes, maximum shear stress and maximum shear stress plane.

(12 + 8)

6A. Determine the diameter of a solid shaft which will transmit 300 kW at 250 r.p.m. The maximum torque being 20 % greater than the mean torque. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 1° in a shaft length of 2 m. Take modulus of rigidity = 1 x 10^5 N/mm^2.

6B. Prove that hollow shaft is stronger and stiffer than a solid shaft of same material, length and weight. **(10 + 10)**

7A. A beam simply supported over a span of 10 m carries concentrated loads of 40kN, 20kN and 60 kN, at 2m, 5m and 9 m from the left hand support. Determine the deflection under point loads. I for the section = 695.054 x 10^6 mm^4 and E = 200 kN/mm^2.

7B. Define the following terms**:** i) Torque ii) Torsional rigidity iii) Deflection iv) Flexural rigidity v) Buckling load

(10 + 10)

8A. Derive the expression for maximum slope and deflection of a cantilever beam subjected to a point load 'P' at its free end.

8B. A 1.5 m long column has a circular cross section of 50 mm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, Calculate the safe load using:

i) Rankine's formula, take yield stress, σ_c = 560 N/mm^2 and a = 1/1600.

ii) Euler's formula, Young's modulus = 1.2 x 10 ^{5} N/mm^2. **(10 + 10)**

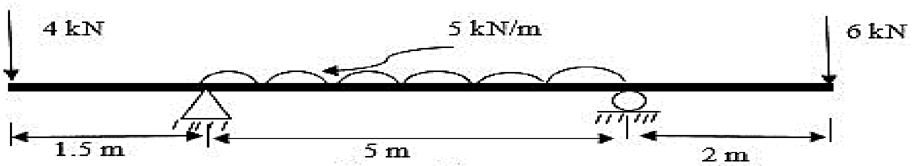

Figure 3A