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BICE-008

B.Tech. CIVIL ENGINEERING (BTCLEVI)

Term-End Examination

June, 2018

00013

BICE-008 : STRUCTURAL ANALYSIS – I

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. Assume any missing data suitably.*

1. (a) A mild steel bar of 12 mm diameter has a brass sleeve around it as shown in Figure 1. The sleeve has an external diameter of 20 mm and an internal diameter of 12 mm. The bar and the sleeve are firmly fixed together at each end and are subjected to a pull of 10 kN. Find the stresses in the bar and brass sleeve due to the pull. Also determine the load carried by

the brass sleeve and steel bar. Take $E_b = 100$ kN/mm^2 and $E_s = 200$ kN/mm^2. 7

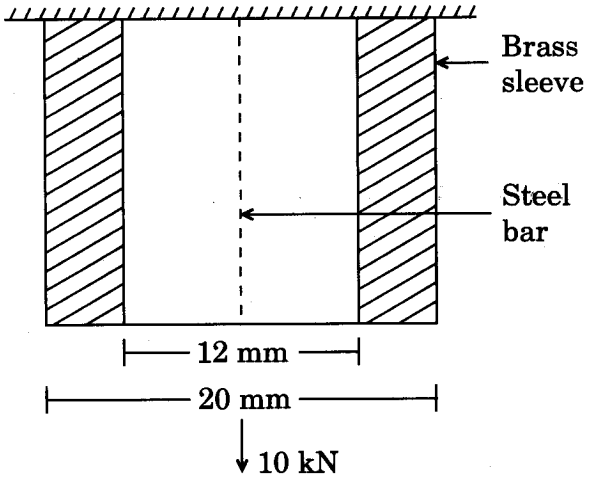

Figure 1

(b) A bar is rigidly fixed between two plates at A and D and is loaded as shown in Figure 2. Find the forces acting on the portions AB, BC and CD and displacements of the points B and C if E = 200 kN/mm^2. Cross-sectional area of portions AB, BC and CD are marked on the figure. 7

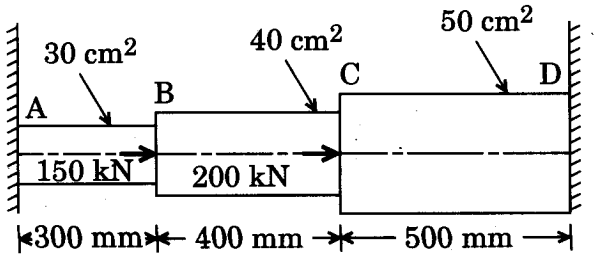

Figure 2

2. (a) The section of a cantilever beam is a hollow rectangle with a width of 4 cm and total depth of 5 cm. Thickness of the beam section throughout is 5 mm. The beam has a length of 3 m. Determine the maximum value of a concentrated load applied at the free end so that the maximum stress in beam section anywhere in the beam does not exceed 80 MPa. 7

(b) Explain the concept of principal stresses with a neat sketch. 7

3. (a) A cantilever is subjected to a downward load of 3000 N at its free end and an upward vertical force of 12000 N at the middle. The cantilever is 12 m long and supports a uniformly distributed downward load of 1000 N/m run. Draw the B.M. and S.F. diagrams for the beam. 7

(b) Show that product of inertia of a T-section about a centroidal axis is zero. 7

4. (a) An axially loaded column 6 m high and having both ends fixed is made up of a wide flanged R.S.J. having the following properties : *10*

Section : 30 cm × 20 cm, Area = 70 cm^2

I_{XX} = 12400 cm^4, I_{YY} = 1760 cm^4

E = 2×10^4 kN/cm^2.

Find the working load of the column using Euler's formula. If one end of the column is fixed and the other end hinged, what will be the working load ? Take factor of safety as 4.

(b) Briefly discuss the limitations of Euler's formula for calculating critical load for a column. *4*

5. (a) Derive the equation of pure bending. *7*

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

where all terms have their usual meaning.

(b) What is the concept of shear centre ? Discuss briefly with an example. *7*

6. (a) A T-section has the following dimensions :
flange : 200 mm × 50 mm,
web : 200 mm × 50 mm.

The section is subjected to a vertical shear force of 200 kN.

Calculate : *10*

(i) Shear stress at the junction of the flange and web.

(ii) Shear stress at the neutral axis.

Sketch the shear stress distribution diagram for T-section.

(b) What is the difference between destructive and non-destructive testing ? *4*

7. Write short notes on any ***two*** of the following topics : *2×7=14*

(a) Mohr Circle

(b) Izod and Charpy Impact Test

(c) Torsion of a Circular Shaft