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[5252]-515

S.E. (Mechanical) (First Semester) EXAMINATION, 2017

STRENGTH OF MATERIALS

(Common to Mechanical/Auto Engineering)

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

*N.B.* :— (i) Solve Q. 1 or 2, Q. 3 or 4, Q. 5 or 6, Q. 7 or Q. 8.

(ii) Figures to the right indicate full marks.

(iii) Use of electronic pocket calculator is allowed.

(iv) Assume suitable data if necessary.

1. (a) A composite bar as shown in Fig. 1 is loaded by various axial forces. Determine largest value of force  $P$  such that stresses in the steel do not exceed 150 Mpa and that in brass does not exceed 75 Mpa. Take  $E_s = 200$  GPa.  $E_b = 75$  GPa. Also find total deformation of composite bar. [6]

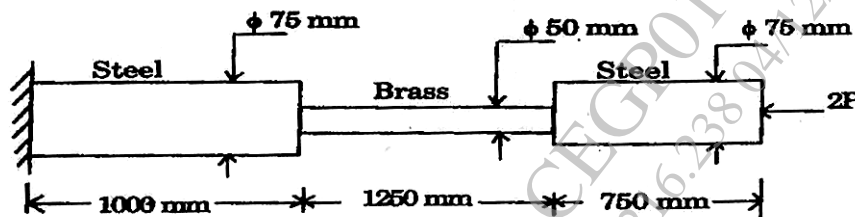


Fig. 1

P.T.O.

- (b) Draw SFD and BMD for the beam shown in Fig 2. Also find point of contra-flexure if any. [6]

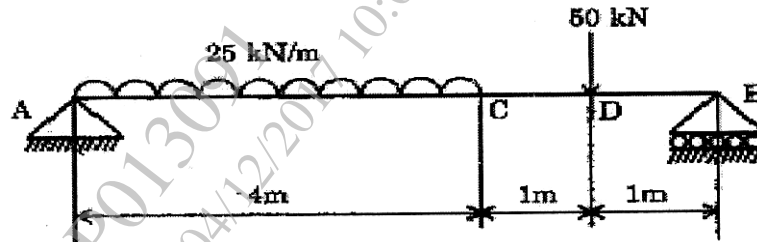


Fig. 2

Or

2. (a) A reinforced concrete column  $300 \times 300$  mm has four reinforcing steel bars of 25 mm diameter. Find safe axial load on the column when the concrete is subjected to stress of  $5 \text{ N/mm}^2$ . What is corresponding stress in steel? Take  $E_s/E_c=18$  [6]
- (b) Fig 3 shows SFD. Draw loading diagram and BMD. Also find point of contraflexure if any. [6]

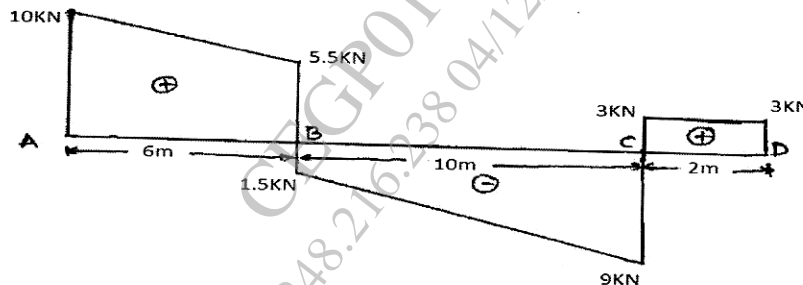


Fig. 3

3. (a) A simply supported beam of 8 m length is loaded as shown in Fig 4. Find deflection under each load. Take  $E = 210 \text{ GPa}$  and  $I = 180 \times 10^6 \text{ mm}^4$ . [6]

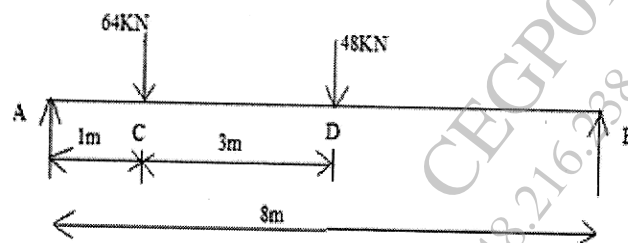


Fig. 4

- (b) Calculate intensity of UDL that SSB of span 4 m and of cross-section as shown in Fig. 5 can carry if permissible stresses in bending are 120 MPa in compression and 40 MPa in tension. [6]

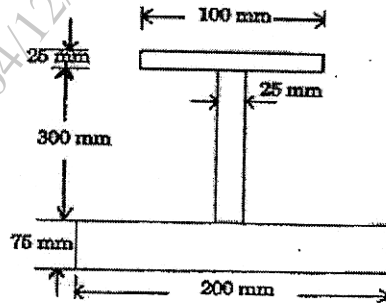


Fig. 5

Or

4. (a) A steel section as shown in Fig. 6 is subjected to a shear force of 200 kN. Determine the shear stress at key points and sketch the shear stress distribution diagram. [6]

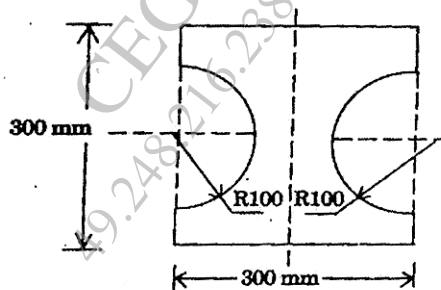
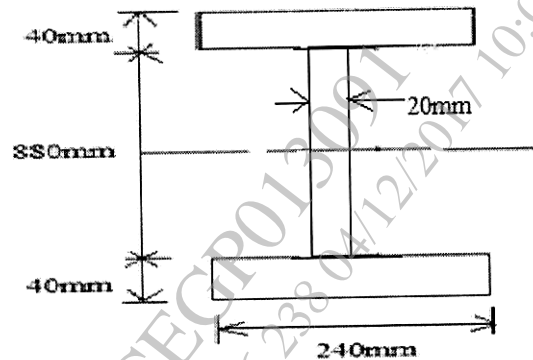


Fig. 6

- (b) A one metre long bar of rectangular cross-section 50 mm  $\times$  80 mm is subjected to axial load of 1.2 kN. Determine the Maximum stress and strain energy developed in the bar if load applied :
- (i) is gradual, and
  - (ii) falls through height of 25 mm. [6]

5. (a) A shaft of hollow circular section has outer diameter 120 mm, inner diameter 100 mm. Permissible shear stress is 95 MPa. Angle of twist is not to exceed  $3.6^\circ$  in a length of 3 m. Maximum torque is 30% excess of mean torque. Speed of shaft is 2 RPS. Determine Maximum power transmitted by shaft. Take  $G = 80$  GPa. [7]
- (b) A simply supported beam of I section as shown in fig. 7 deflects 12 mm when subjected to Udl of 50 kN/m. Determine safe load if beam is used as column with both ends fixed. Use Euler's formula with factor of safety 5. Take  $E = 205$  GPa. [6]



**Fig. 7**

*Or*

- (a) A solid shaft of 160 mm diameter has same cross-sectional area as that of hollow shaft of same material of inside diameter 110 mm. Find ratio of power transmitted by two shafts of same angular velocity. [6]
- (b) A steel bar of rectangular cross-section  $55 \times 45$  mm pinned at each end and subjected to axial Compression. The bar is 2.3 m long and  $E = 210$  GPa. Compare Euler's critical load with Rankine load. Take  $\sigma_c = 550$  MPa and  $a = 1/1600$ . [7]

7. (a) A plane element is subjected to stresses as shown in fig 8. Determine principal stresses, maximum principal stress and position of principal plane. [7]

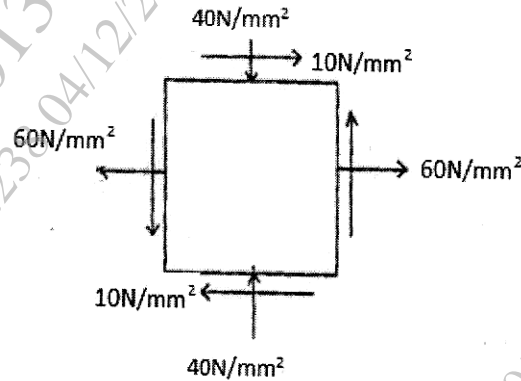


Fig. 8

- (b) A shaft is subjected to maximum torque of 14 kN-m and maximum bending moment of 10 kN-m determine diameter of shaft according to maximum shear stress theory. Elastic limit in simple tension test is 180 MPa. [6]
- Or
8. (a) In simple tension test, a test specimen of 10 mm diameter is gradually loaded from zero to 20 kN within elastic limit. Draw Mohr's circle and find Maximum shear stress developed. [6]
- (b) The axial pull of 20 kN along with a shear force of 15 kN is applied to circular bar of 20 mm diameter. The elastic limit of material is 230 MPa and Poisson's ratio is 0.3 Determine factor of safety according to :
- (i) Maximum shear stress theory
  - (ii) Maximum shear strain energy theory. [7]