shear stress developed in each of them are same, find out the ratio of weights of solid shaft to the hollow shaft.

12

Group – E

8. (a) A cantilever beam shown in Fig.6, of span L is carrying a point load W at B. The moment of inertia for the left half is 2I, whereas that for the right half is I. Find the slope and deflection at free end in terms of EI, W and L. Use conjugate beam method.

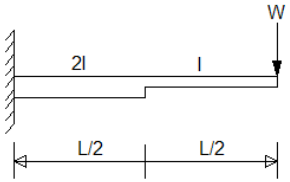

Fig.6

(b) What is meant by true stress and engineering stress? Derive the expression for strain energy stored in a bar due to axial force.

10 + 2 = 12

9. (a) Determine the lateral deflections at failures of a 5 m. long aluminium column of 100 mm. external diameter and 5 mm. wall thickness for 'both ends hinged' and 'both ends fixed' boundary conditions. Assume a yield stress of 290 MPa and Young's modulus of 72 GPa.

(b) Find out the critical load for a long column having one end fixed and other end free using Euler's theory. The column has length '*l*', uniform cross-sectional area 'A' and rigidity 'EI'.

6 + 6 = 12

STRENGTH OF MATERIALS
(CIVL 2102)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Maximum deflection of a cantilever beam carrying a point load *P* at the free end with length *l*, Young's modulus E and moment of inertia I is given by
(a) Pl/3EI (b) 3Pl/EI (c) Pl^3/EI (d) $Pl^3/3EI$.

(ii) The loading on the conjugate beam is
(a) the load actually applied on the given beam
(b) the shear force diagram/EI
(c) the elastic curve of the beam under the given load system
(d) the bending moment diagram/EI.

(iii) An inverted T-section is subjected to a shear force F. The maximum shear stress will occur at
(a) top of the section (b) neutral axis of the section
(c) junction of web and flange (d) bottom of the section.

(iv) Maximum bending moment in a cantilever carrying a point load at the free end occurs at the
(a) free end (b) mid-span
(c) fixed end (d) at the third point from the fixed end.

(v) Point of contraflexure is that point, where
(a) bending moment diagram changes its sign
(b) shear force diagram changes its sign
(c) axial force diagram changes its sign
(d) bending moment takes a value zero

(vi) Hook's law holds good upto
(a) elastic limit (b) proportional limit
(c) breaking point (d) plastic limit.

(vii) What is the elongation of a tapered circular bar (diameter 'd_1' reduces to 'd_2' from left hand side to the right hand side) of length 'l' subjected to uniaxial tension 'T'?

(a) $\frac{4Tl}{\pi E d_1 d_2}$ (b) $\frac{16Tl}{\pi E d_1 d_2}$ (c) $\frac{4T\pi}{E l d_1 d_2}$ (d) $\frac{16T\pi}{E l d_1 d_2}$

(viii) If a point is subjected to tensile stresses of same intensity acting along the perpendicular directions, principal stresses would be inclined at

(a) 45^0 (b) 0^0 (c) 90^0 (d) 120^0.

(ix) If σ_1 and σ_2 are major and minor principal stresses, then the maximum value of shear stress is given by

(a) $(\sigma_1 - \sigma_2)/3$ (b) $(\sigma_1 - \sigma_2)/2$
(c) $(\sigma_1^2 - \sigma_2^2)/2$ (d) $(\sigma_1 - \sigma_2)/4$.

(x) The ratio of critical buckling load for columns with both ends hinged to columns with both ends fixed is

(a) 0.25 (b) 4 (c) 0.5 (d) 2.

Group – B

2. (a) Determine the load '*P*' by maintaining the static equilibrium of the axially loaded bar shown in the Fig.1. Also determine the change in length of the bar. Take *E* = 200 GPa.

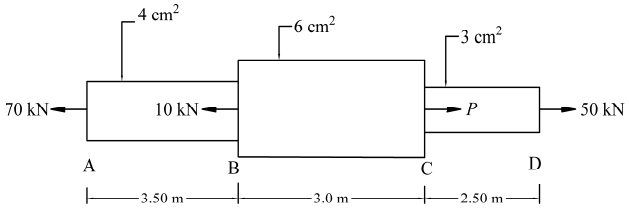

Fig.1

(b) A square element is subjected to the two dimensional state of stress as shown in the Fig.2. Find out the major and minor principal stresses and the maximum shear stress using Mohr circle. Find out the normal and shear stresses on a plane incline at an angle 35 degree with the principal plane.

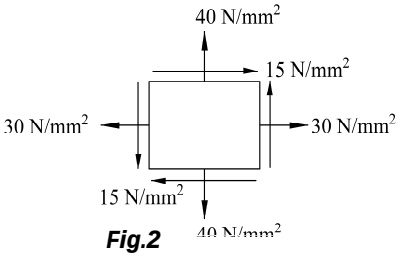

Fig.2

5 + 7 = 12

3. (a) What do you mean by "Degrees of freedom"?

(b) Explain the terms Hoop and meridonial stresses.

(c) Draw and explain the stress-strain diagram of mild steel.

3 + 3 + 6 = 12

Group – C

4. Draw the SFD and BMD of the following beams shown in Fig.3 and Fig.4.

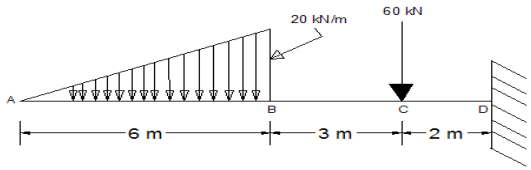

Fig.3

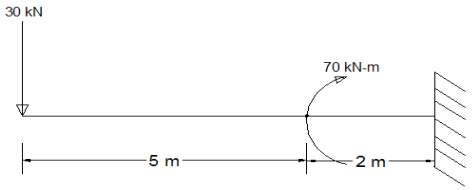

Fig.4

(6 + 6) = 12

5. (a) Show that the following relation holds true. Symbols have their usual meanings. $M/I = \sigma/y = E/R$.

(b) Write down the assumptions in theory of simple bending.

(c) Explain the term shear flow.

6 + 4 + 2 = 12

Group – D

6. Find out the member forces for the truss shown in the Fig.5 by using method of joints.

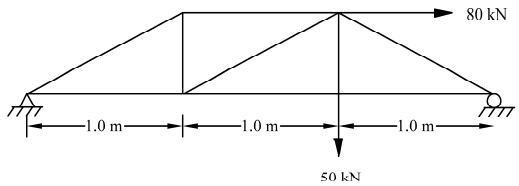

Fig.5

12

7. Two shafts of same material and same length are subjected to same torque. If the first shaft is of solid circular section and the second shaft is of hollow circular section whose internal diameter is 3/4th the external diameter and the maximum