

- B. (1) Question No. 1 is compulsory.  
 (2) Answer any four of the remaining six questions.  
 (3) Figures to the right indicate marks.  
 (4) Assume missing data suitably.

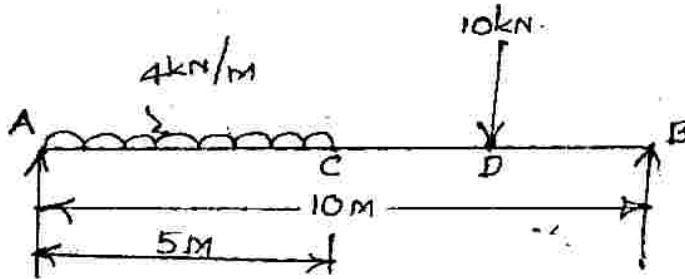
Define and explain in brief :

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- |                            |                       |
|----------------------------|-----------------------|
| (a) Hooke's law            | (f) Hoop stress       |
| (b) Point of contraflexure | (g) Principal planes  |
| (c) Section modulus        | (h) Slenderness ratio |
| (d) Rigidity modulus       | (i) Proof stress      |
| (e) Core of a section      | (j) Factor of safety. |

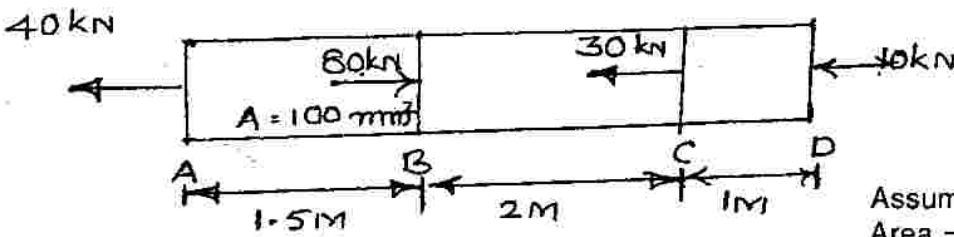
- (a) Sketch SFD, BMD and max. Bending moment for a beam shown.

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- (b) Find the total change in length of the bar shown in figure.

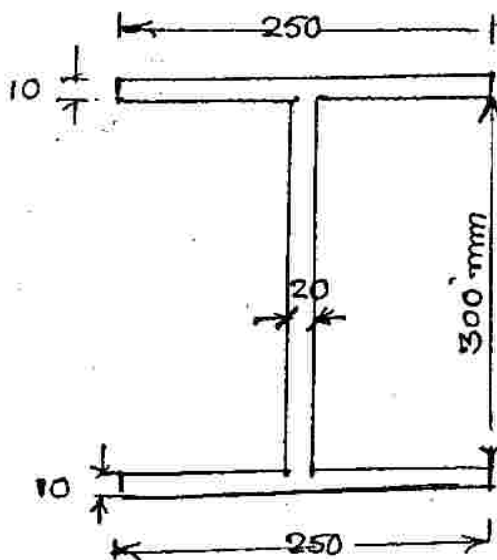
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Assume  $E = 2 \times 10^5 \text{ N/mm}^2$   
 Area =  $100 \text{ mm}^2$   
 (through out the bar)

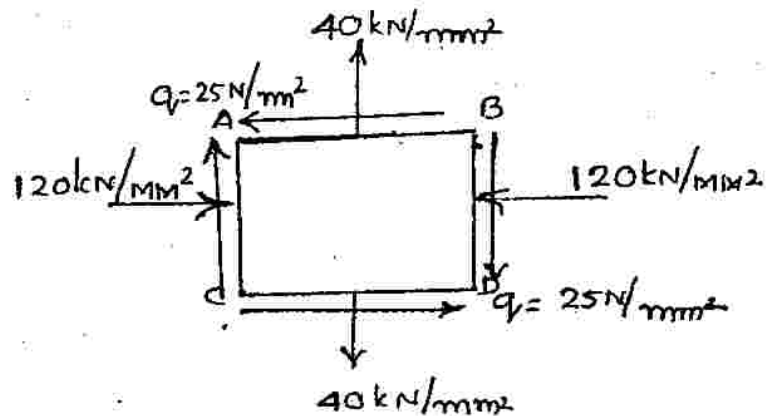
- (a) Find the area of the Core of I-section shown in figure.

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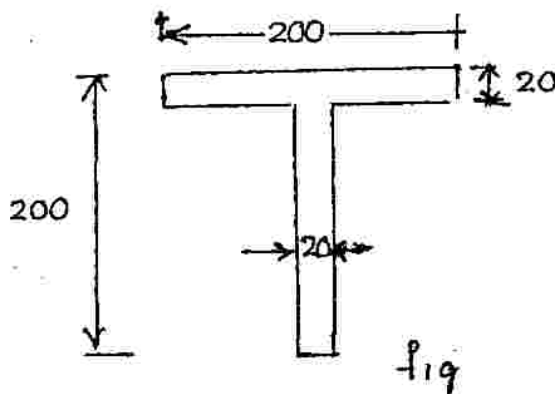
(b) For a strained material shown in figure.



- (i) Find major and minor principal stresses and their locations.
- (ii) Max shear stress and plane of maximum shear.

4. (a) Prove  $\frac{M}{I} = \frac{f}{Y} = \frac{E}{R}$  with usual notations.

(b)



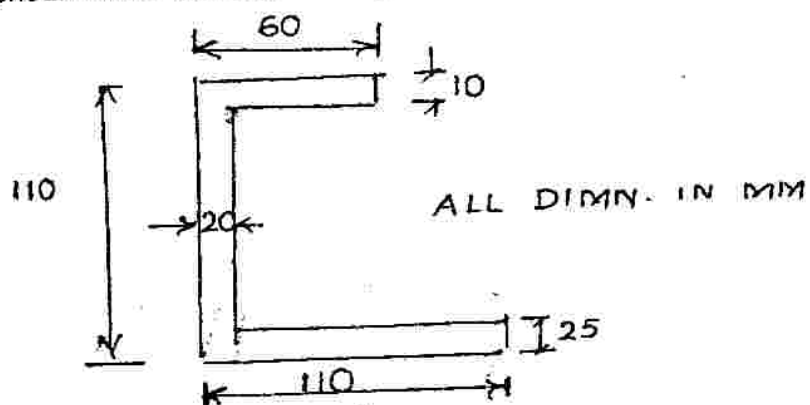
Assuming

Bending moment of 20 kN-M (Sagging)

Find :

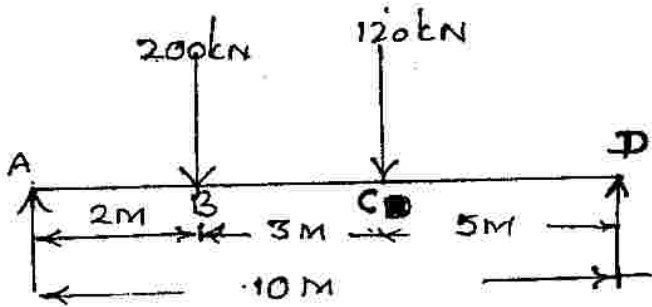
- (i) Depth of Neutral axis
- (ii) Maximum bending stresses in compression and tension.
- (iii) Magnitude of compressive force on top flange
- (iv) Bending stress at the junction of flange and web.

5. (a) Sketch shear stress distribution diagram across the section take shear force 100 kN.



- (b) Find slope and deflection at points B and C shown below :  
Value of EI throughout the span of the beam is constant.

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$$E = 200 \text{ kN/mm}^2$$

$$I = 18 \times 10^8 \text{ mm}^4$$

- (a) Prove  $\frac{T}{I_p} = \frac{q}{R} = \frac{C \theta}{l}$  with usual notations. 5

- (b) For a hollow circular shaft having internal diameter 0.5 times the external diameter is to be designed to transmit 50 kW at a speed of 7.5 Hz and shear stress is not to exceed 85 N/mm<sup>2</sup>. 15

Calculate :

- (i) External diameter of the hollow shaft
- (ii) The angle of twist in degrees between sections 1.5 M apart.
- (iii) Find the % saving in material of the hollow shaft. Compared with a solid shaft designed for the same condition.

- (a) A thin cylindrical shell 4 m long and 80 cm in internal diameter with 12 mm thick plates is having longitudinal riveted joint with 70% efficiency. This shell is subjected to internal fluid pressure of 200 N/mm<sup>2</sup>. Find the changes in length, diameter and volume of the shell. Take Poisson's ratio as 0.3 and  $E = 2 \times 10^5 \text{ N/mm}^2$ .

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- (b) A strut built up of two  $250 \times 75$  mm channels placed back to back at a distance of 100 mm apart and rivetted to flange plates each 300 mm wide and 12 mm thick as shown in the figure.

Calculate the second moment of the area about axis AA and BB. (Neglect the effect of rivets)

Properties of one channel are :

$$A = 36.6 \text{ cm}^2, I_{xx} = 3440 \text{ cm}^4, I_{yy} = 166 \text{ cm}^4.$$

Distance of the centroid  $G_1$  from back = 19 mm and the effective length is 5 m. Calculate the working load using Rankines formula.

Take  $\sigma_c = 90 \text{ N/mm}^2$        $\alpha = \frac{1}{7500}$       and F.S. = 4.

