



17311

16117

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) *All questions are compulsory.*
(2) *Answer each next main question on a new page.*
(3) *Illustrate your answers with neat sketches wherever necessary.*
(4) *Figures to the right indicate full marks.*
(5) *Assume suitable data, if necessary.*
(6) *Use of Non-programmable Electronic Pocket Calculator is permissible.*
(7) *Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.*

Marks

1. A) Solve **any six** of the following :

12

- Define moment of Inertia.
- If polar moment of inertia of a circular section is 2000 mm^4 then calculate diameter of the section.
- Define modulus of rigidity.
- State meaning of punching shear stress.
- State four conditions for effective lengths of a column depend on their end fixities.
- State meaning of effective length of column.
- Define resilience and modulus of resilience.
- Differentiate between gradual load and suddenly applied load with respect to stress developed.

B) Solve **any two** of the following :

8

- State bending equation with meaning of each term used in it.
- A beam of rectangular cross-section is subjected to shear force 'S'. Show that $q_{\text{maximum}} = 1.5 q_{\text{avg}}$.
- A column having diameter 200 mm is of length 3 m, both ends of column are hinged. Find Euler's crippling load. Take $E = 2 \times 10^5 \text{ MPa}$.

P.T.O.



2. Solve **any two** of the following :

16

- a) Find the least moment of Inertia about the centroidal axes X-X and Y-Y of an unequal angle section $125 \text{ mm} \times 75 \text{ mm} \times 10 \text{ mm}$ as shown in figure No. 1.

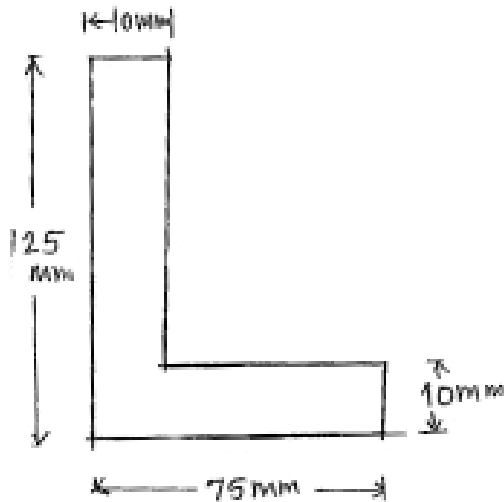


Figure No. 1

- b) Determine moment of Inertia about the centroidal axes X-X and Y-Y of an Unsymmetrical I section with following details.
 Top flange – $100 \text{ mm} \times 20 \text{ mm}$
 Bottom flange – $160 \text{ mm} \times 20 \text{ mm}$
 Web – $80 \text{ mm} \times 20 \text{ mm}$.
- c) i) Find moment of Inertia about the diagonal of a square section having diagonal 400 mm .
 ii) Draw stress - strain curve for mild steel under tensile loading showing important points on it.

3. Solve **any two** of the following :

16

- a) Determine the total elongation of the bar shown in figure No. 2. Take $E = 2 \times 10^5 \text{ N/mm}^2$.

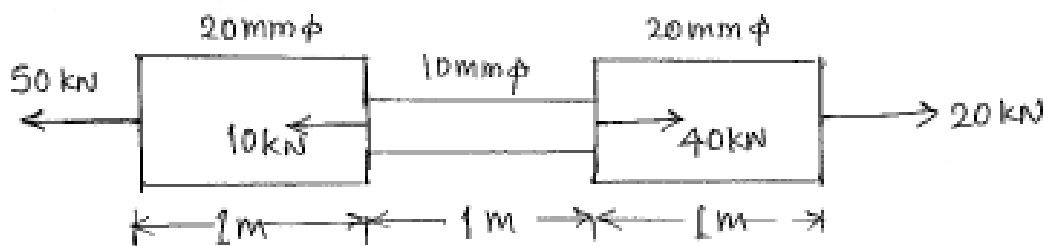


Figure No. 2



- b) A RCC column $400 \text{ mm} \times 400 \text{ mm}$ is reinforced with 4 bars of 20 mm diameter. Determine the stresses induced in steel and concrete. If it is subjected to an axial load of 500 kN and modular ratio is 13.
- c) A bar of cross section $20 \text{ mm} \times 40 \text{ mm}$ and length 500 mm is subjected to axial tensile force of 50 kN. The change in length is 0.20 mm. Determine change in depth and change in width and change in volume of bar. Take $\mu = 0.30$ and $E = 2 \times 10^5 \text{ N/mm}^2$.

4. Solve any two of the following :

16

- a) In a biaxial stress system as shown in figure No. 3, the stresses along the two perpendicular directions. Calculate the strains along these two directions. Take $E = 2.1 \times 10^5 \text{ N/mm}^2$ and $\mu = 0.28$. Also find change in length in both directions if section is square of 4 m.

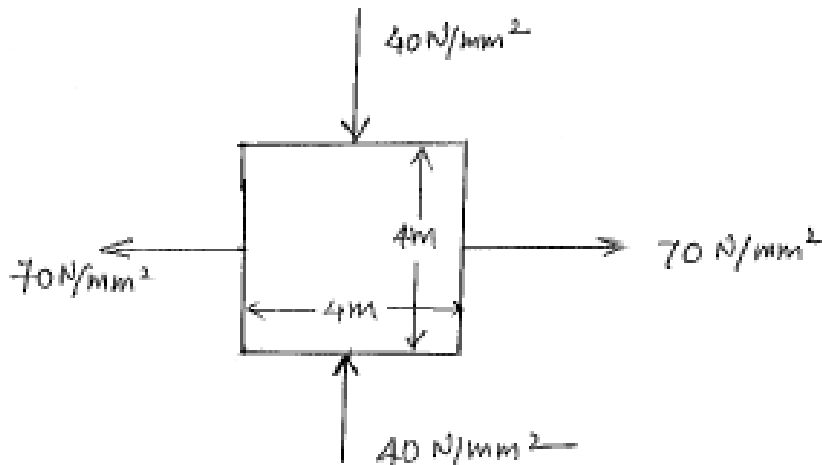


Figure No. 3

- b) A rod is subjected to an initial compressive stress 50 N/mm^2 and held in rigid supports at temperature of 50°C . Find
- The temperature at which rod will become stress free.
 - What tensile stress will be developed at temperature 30°C ?
 - What will be compressive stress at temperature 30°C ?
 - What will be elongation of rod at temperature 30°C ?

Take $\alpha = 12 \times 10^{-6} / ^\circ \text{C}$.

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

c/s Area = 400 mm^2

length = 4 m

- c) An over hanging beam ABC is such that $AB = 4 \text{ m}$, $BC = 1 \text{ m}$, is supported at A and B. The beam ABC is subjected to vdl of 30 kN/m over the entire length ABC. It is subjected to point load 50 kN at the free end C. Draw SFD and BMD with calculations and locate the point of contra flexure.



5. Solve **any two** of the following :

- a) Draw SFD and BMD with calculations for the beam shown in figure No. 4.

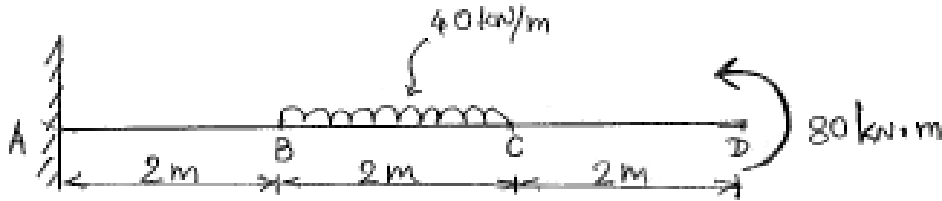


Figure No. 4

- b) i) State relation between shear force and rate of loading and also relation between shear force and bending moment.

- ii) Draw SFD and BMD with calculations for the beam shown in figure No. 5.

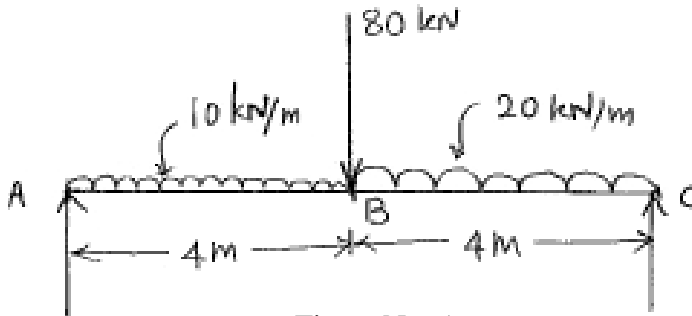


Figure No. 5

- c) A T section of flange $160 \text{ mm} \times 20 \text{ mm}$ and web $180 \times 20 \text{ mm}$ is simply supported at the both ends. It carries two concentrated loads of 100 kN each acting 2 m distance from each support. Span of the beam is 8 m . Determine the maximum bending stress induced in the beam and draw bending stress distribution diagram and also find bending stress at the layer 100 mm from the bottom.

6. Solve **any two** of the following :

- a) A beam has hollow rectangular section with external dimensions $80 \text{ mm} \times 160 \text{ mm}$ and uniform thickness of section is 10 mm . Draw shear stress variation diagram. It section is subjected to the shear force 70 kN . Also determine ratio of maximum shear stress and average shear stress.
- b) A hollow circular column 6 m long has to transmit a load of 800 kN , using Rankine's formula and factor of safety 4 . Design a suitable section if both ends of columns are fixed.

Take internal diameter = $0.8 \times$ external dia. $f_c = 550 \text{ MPa}$, $\alpha = \frac{1}{1600}$.

- c) A bar 10 mm diameter is subjected to following cases. Determine strain energy stored and modulus of resilience in following cases.
- i) A gradually applied load of 800 N stretches bar by 0.3 mm .
- ii) A impact load of 800 N is dropped by 80 mm on the collar attach at the lower end of the bar. Take $E = 200 \text{ GPa}$.