

Sl. No.

18401

A-FTF-J-DFA

## CIVIL ENGINEERING

Paper I

(Conventional)

Time Allowed : Three Hours

Maximum Marks : 200

### INSTRUCTIONS

*Candidates should attempt any FIVE questions.*

*The number of marks carried by each subdivision of a question is indicated at the end of the subdivision.*

*The total number of marks for each question will be 40.*

*Wherever a question is attempted, all its subdivisions are to be attempted.*

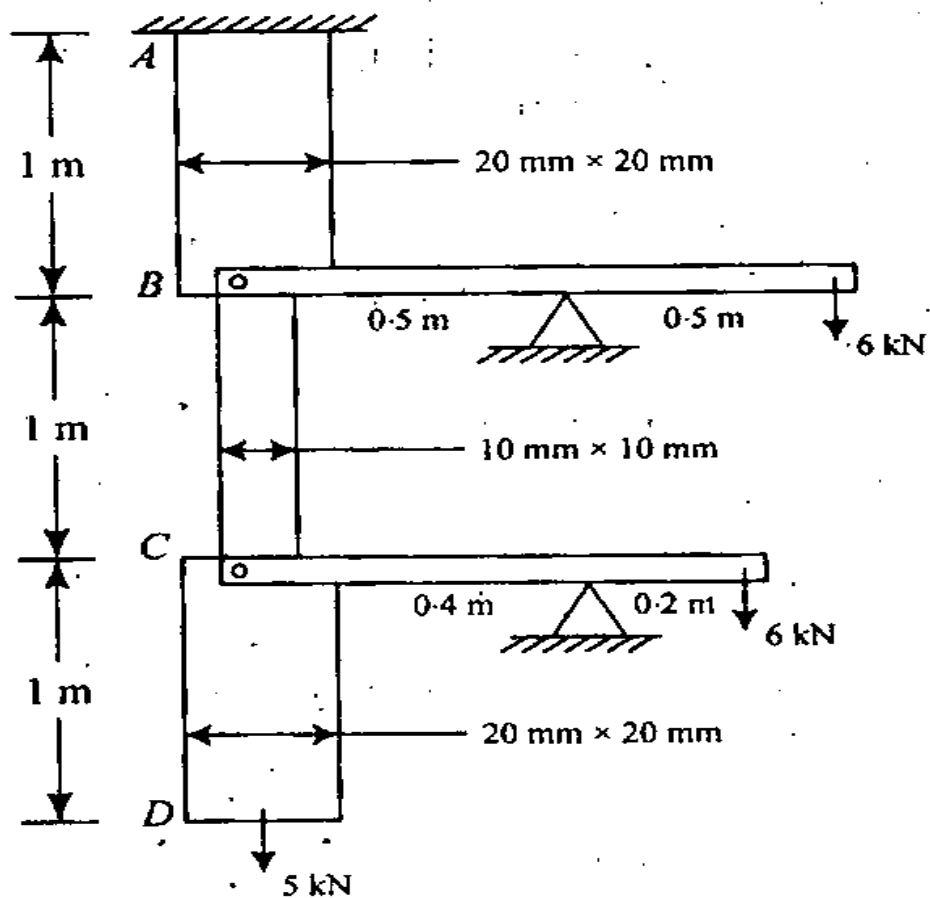
*Notations used are standard and will have their usual meanings.*

*Assume suitable data, if found necessary, and indicate them clearly. Newton may be converted to kgf using the relation 1 kilonewton (1 kN) = 100 kgf, if found necessary.*

*Answers must be written in ENGLISH.*

1. (a) (i) Draw a sketch showing the typical creep strain-time curve under uniaxial compression for concrete. 4
- (ii) Draw a neat sketch of macrostructure of exogenous tree. 3
- (iii) Draw neat sketches showing various types of shakes. 3
- (b) (i) Why is seasoning of timber required? List out the methods of seasoning. 4
- (ii) Write briefly on the composition and properties of refractory bricks. 6
- (c) Briefly describe the admixtures generally used in concrete and the properties they impart to the concrete. 10
- (d) (i) Give a detailed account of the cylinder splitting test of concrete. 8
- (ii) What are the limitations of the above test in evaluating the real tensile strength of concrete. 2

2. (a)



A stepped vertical steel bar  $ABCD$  is fixed at the top end  $A$ . Each segment of the bar  $AB$ ,  $BC$  and  $CD$  is 1 m long and has cross-sections  $20 \text{ mm} \times 20 \text{ mm}$ ,  $10 \text{ mm} \times 10 \text{ mm}$  and  $20 \text{ mm} \times 20 \text{ mm}$  respectively. A 5 kN load is applied directly at  $D$  and 6 kN loads are applied on the levers attached to the stepped bar at  $B$  and  $C$  as shown in the above figure. Find the vertical displacement of  $D$  and the change in volume of the bar.

$E = 2 \times 10^5 \text{ MPa}$  and Poisson's ratio  $\mu = 0.25$ . Connections between the levers and bar at  $B$  and  $C$  are hinged.

15

- (b) A cantilever beam with circular cross-section of radius 100 mm is subjected to a uniformly distributed load over the entire span. It is given that the deflected shape of the beam has a maximum curvature of  $1.018592 \times 10^{-6} \text{ mm}^{-1}$  and a maximum shear force of 1 kN. Find the intensity of loading on the beam and its span.

$$E = 2 \times 10^5 \text{ MPa.} \quad 10$$

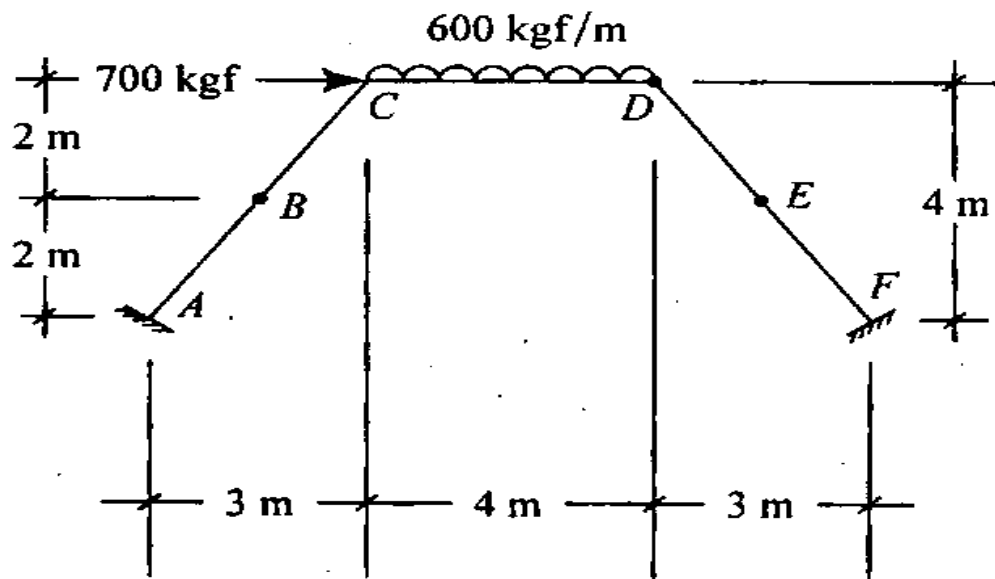
- (c) A solid circular shaft of diameter 50 mm is subjected to pure bending of 3.5 kN-m. Find the maximum twisting moment that can be applied on this shaft such that the material of the shaft does not yield. Use Tresca's theory (maximum shear stress theory) of failure. The yield stress of the material in uniaxial tension is  $400 \text{ N/mm}^2$ .

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3. (a) A uniformly distributed load of 2000 kg/m, 6 m long crosses over a girder simply supported at ends over a span of 10 m from left to right. Calculate maximum bending moment in the girder at a point 4.5 m from left hand end using influence lines.

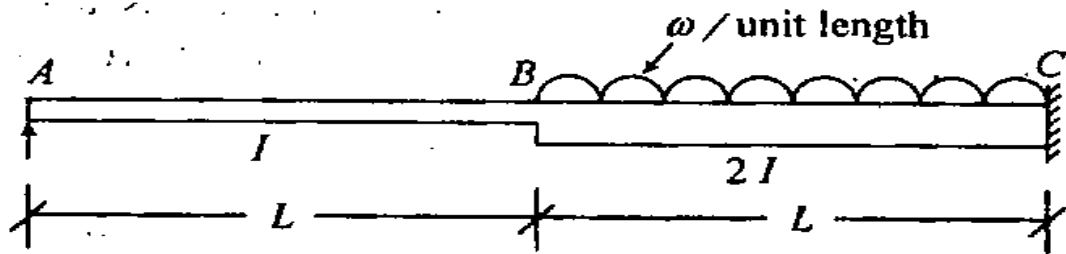
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(b)



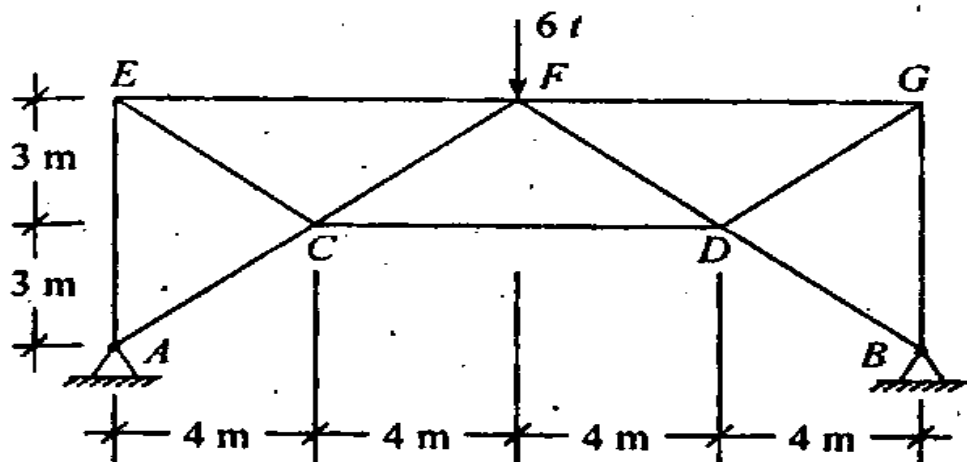
A portal frame  $ABCDEF$  with inclined legs has hinges at  $B$ ,  $D$  and  $E$  as shown in the above figure. Joint at  $C$  is monolithic. Supports at  $A$  and  $F$  are fixed. Calculate all components of reactions. 20

4. (a)



A stepped beam  $ABC$ , simply supported at  $A$  and fixed at  $C$  as shown in the above figure carries a uniformly distributed load of intensity ' $\omega$ ' per unit length over  $BC$ . Determine the vertical reaction at  $A$  using moment area or energy method. 20

(b)



All the members of steel truss shown in the above figure are pin-jointed and have same area of cross-section. Calculate the vertical and horizontal components of the reactions at  $A$  and  $B$ . 20

5. (a) An unequal angle section 200 mm × 150 mm × 15 mm is to be used in a truss as a strut of length 4.5 m. The cross-sectional properties of the section are as follows :

$$\text{Area of cross-section} = 5025 \text{ mm}^2$$

$$I_{xx} = 2 \times 10^7 \text{ mm}^4; I_{yy} = 9.7 \times 10^6 \text{ mm}^4;$$

$$I_{xy} = -8.3 \times 10^6 \text{ mm}^4$$

using the table of permissible compressive stresses given below, determine the safe load on the member.

|   |     |     |     |     |     |     |     |     |     |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <i>Slenderness Ratio</i>                  | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 |
| <i>Permissible compressive stress MPa</i> | 80  | 72  | 64  | 57  | 51  | 45  | 41  | 37  | 33  |

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- (b) A mild steel *T* section has the following cross-sectional dimensions :

$$\text{Total depth} = 200 \text{ mm}$$

$$\text{Width of flange} = 120 \text{ mm}$$

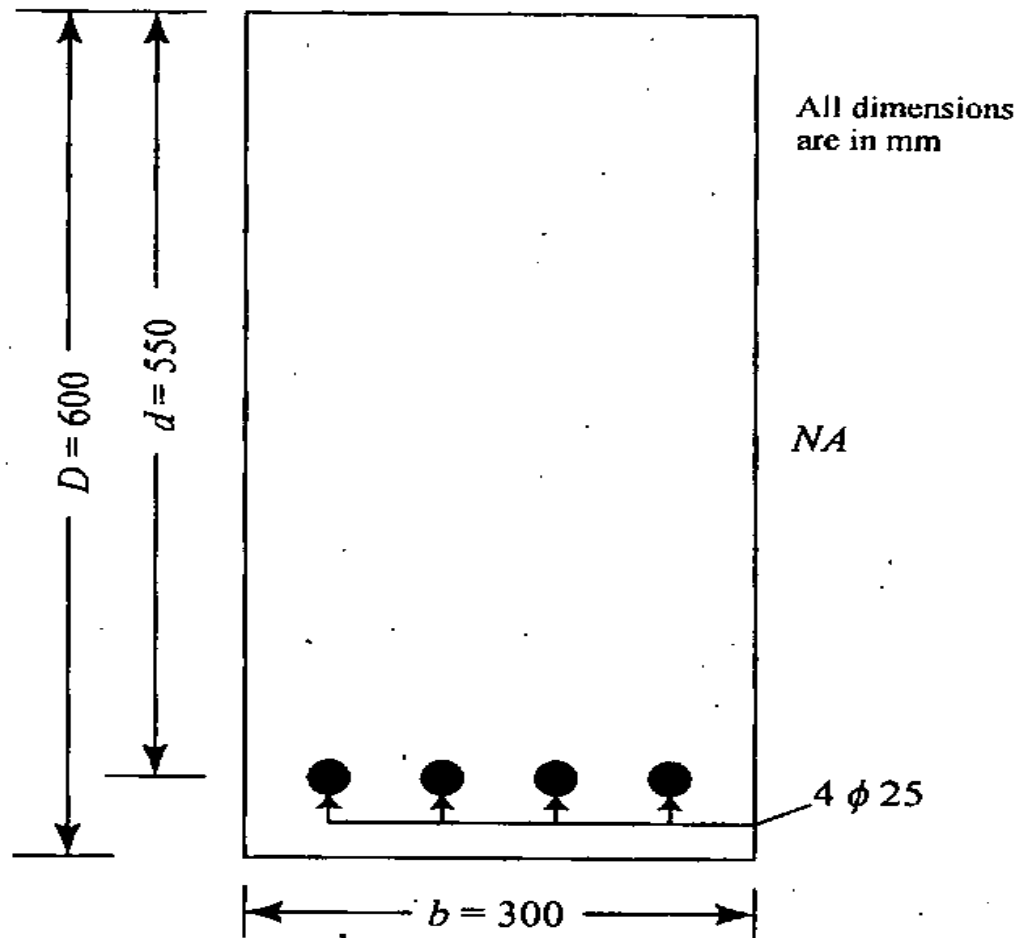
$$\text{Thickness of flange} = 20 \text{ mm}$$

$$\text{Thickness of web} = 20 \text{ mm}$$

If the yield stress,  $\sigma_y = 250 \text{ MPa}$  determine the plastic moment capacity of the section. Also calculate the shape factor for the section.

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6. (a)



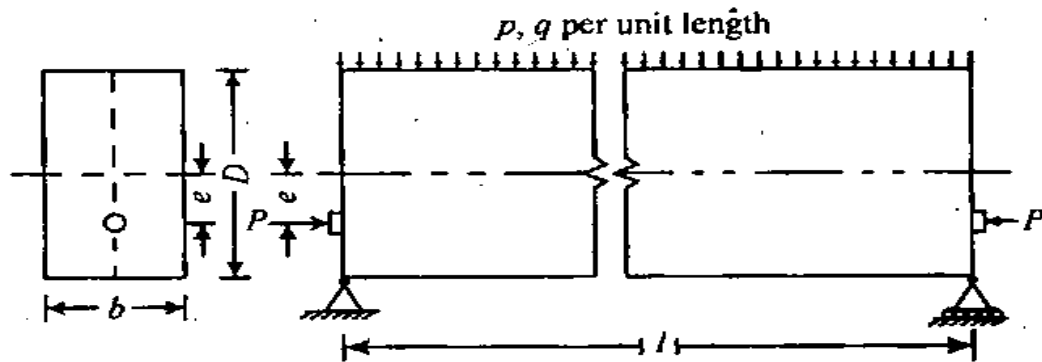
A reinforced concrete beam of rectangular cross-section (600 mm  $\times$  300 mm) is shown in the above figure. Assume M20 grade concrete and  $F_e$  415 grade steel. Permissible compressive stress of concrete in bending  $\sigma_{cbc} = 7.0$  MPa for M20 concrete.

Compute the maximum stresses in concrete and steel when a moment of 50 kNm is applied to the cross-section.

25



(b)



A simply supported high strength concrete beam of rectangular cross-section ( $b \times D$ ), shown in the above figure, supports uniformly distributed dead and live loads of intensities  $p$  and  $q$  per unit length respectively. The beam is prestressed by a straight tendon carrying a prestressing force  $P$  at an eccentricity  $e$ . Show clearly and neatly the stress distributions, through the beam depth, due to eccentric prestressing, dead and live loads at a cross-section where maximum stresses occur. 15

7. (a) (i) Briefly explain the different types of bulldozers according to their uses. 6
- (ii) Explain the Derrick crane with a neat sketch. 4

(b) (i) Enlist and explain Time estimates in PERT. 6

(ii) Explain Resources Allocation. 4

(c) A construction work consists of activities with PERT durations in days as given below :

| Activity    | P | Q    | R | S | T  | U | W  | Y  | Z    |
|-------------|---|------|---|---|----|---|----|----|------|
| Predecessor | - | P, T | Q | - | S  | - | S  | S  | U, W |
| $t_o$       | 3 | 4    | 4 | 3 | 8  | 1 | 2  | 4  | 6    |
| $t_m$       | 6 | 8    | 5 | 3 | 14 | 4 | 5  | 7  | 15   |
| $t_p$       | 9 | 9    | 9 | 3 | 17 | 7 | 14 | 13 | 30   |

Determine :

- (i) The probability of completing the job in 32 days and
- (ii) The completion time with 50% probability.

| Z    | Probability % |
|------|---------------|
| -1.5 | 0.07          |
| -1.3 | 0.10          |
| -1.0 | 0.16          |

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- (d) Calculate optimum cost and optimum duration for jobs of network given in the table below :

| Activity | Normal           |             | Crash            |             |
|----------|------------------|-------------|------------------|-------------|
|          | Duration<br>Days | Cost<br>Rs. | Duration<br>Days | Cost<br>Rs. |
| 1-2      | 5                | 4000        | 4                | 5000        |
| 1-3      | 7                | 8000        | 3                | 10000       |
| 2-3      | 6                | 6000        | 2                | 8400        |

Indirect cost = Rs. 1000/- per day. Sketch project time-cost diagram. 10

