2022

CIVIL ENGINEERING

CSM(O)/CE-I/22

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

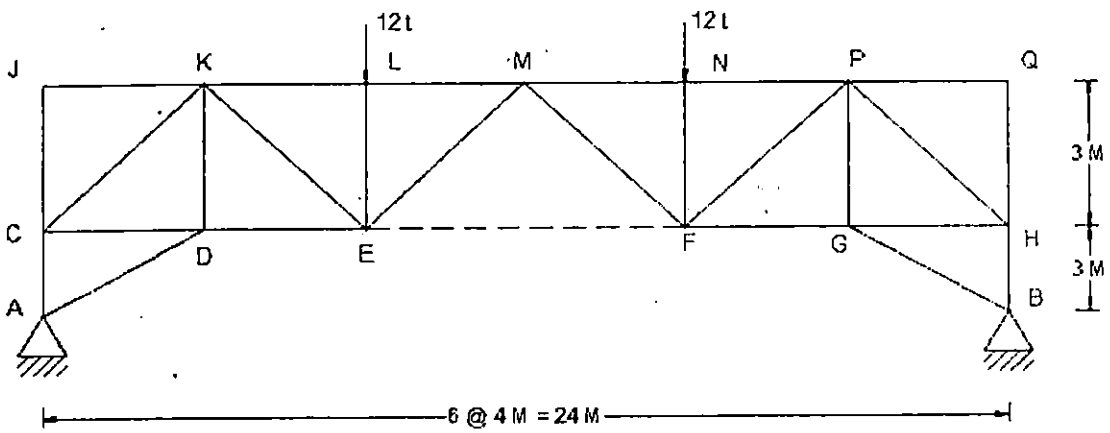
Answer may be written either in **English** *or in* **Bengali** *but all answer must be in one and the same language.*

All notations / symbols have their usual meanings, unless otherwise specified.

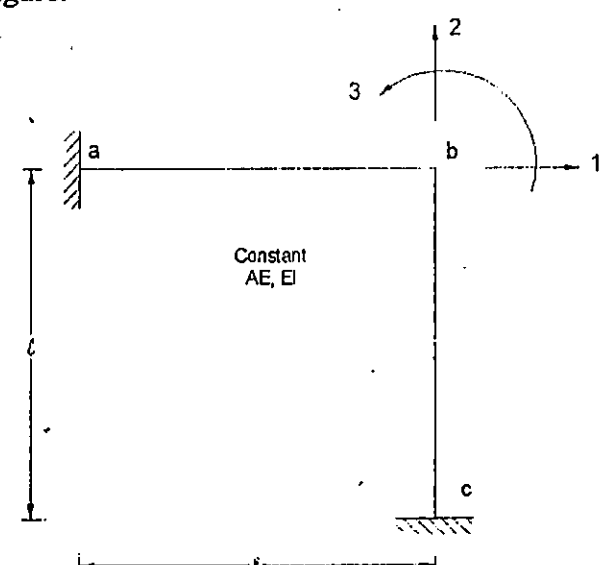
Group-A

Answer any Four questions 32 x 4 = 128

1. a) Assuming all members of the truss shown below to be pin joined, calculate forces in all members.----------20



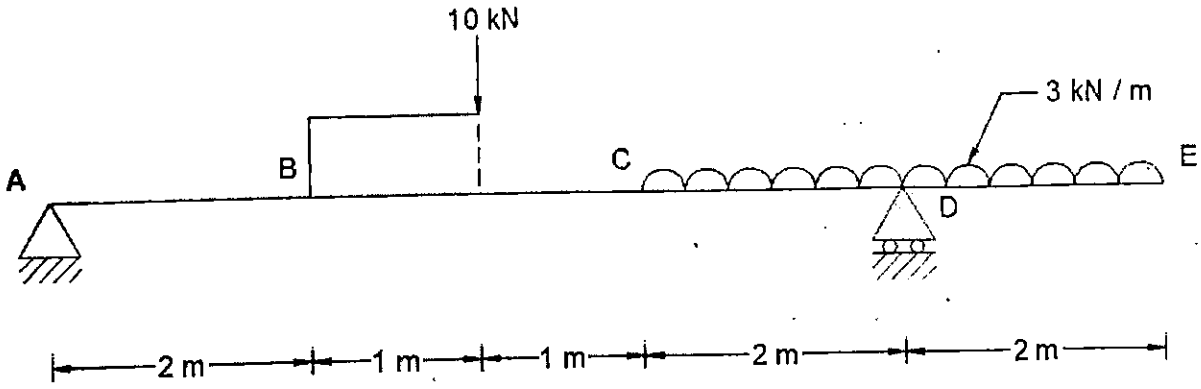
b) Generate the stiffness matrix for the frame corresponding to Three degree of freedom **(1,2,3) in the below figure.** -------- 12



P.T.O

2. a) i)What are the assumptions in Euler's theory of long columns. ----------5
   ii)Write with expressions – the definition of and comparison of Modulus of Elasticity and Modulus of Rigidity? --------- 7

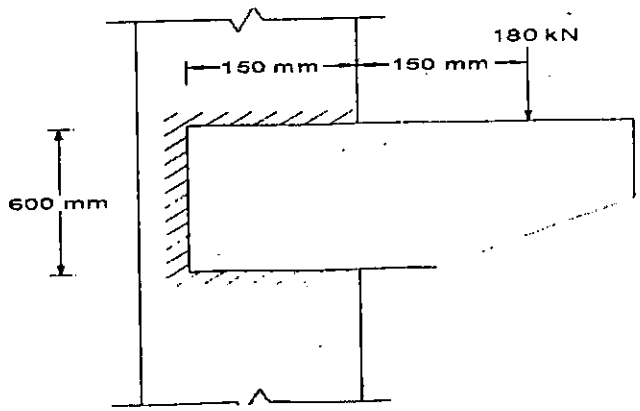
   b) Calculate and draw the Bending Moment and Shear Force Diagramwith values and sign conventions. ---------- 20



3. a) Define Permeability of Soil. What are the factors on which Permeability depend upon. What is the co-efficient of Permeability? ------- 4+4+4
   b) Describe Mohr's Circle and Coulomb's Law with expression. Draw and describe the required steps to be followed. -----10 +10

4. a) Describe in detail, the difference between 'Working Stress Method' of design and 'Limit state method' of design. Explain if there is any Economic advantage between the two, then What and How? ----------8+4= 12

   b) A Column of 9.0m. effective length has to support an Axial Load of 1200kN. Design the Column consisting of Two Channel Sections placed back to back at a suitable spacing and connected through a diagonal lacing system. Consider, $f_y = 250\ N / mm^2$ ---------- 20



Contd. P3

5. a) A reinforced concrete wall of 175mm. thickness and 3.2m. Effective Height is needed to withstand a compressive Load of 1000kN/m. Design the wall using M15 grade Concrete and Mild steel reinforcement ----------8

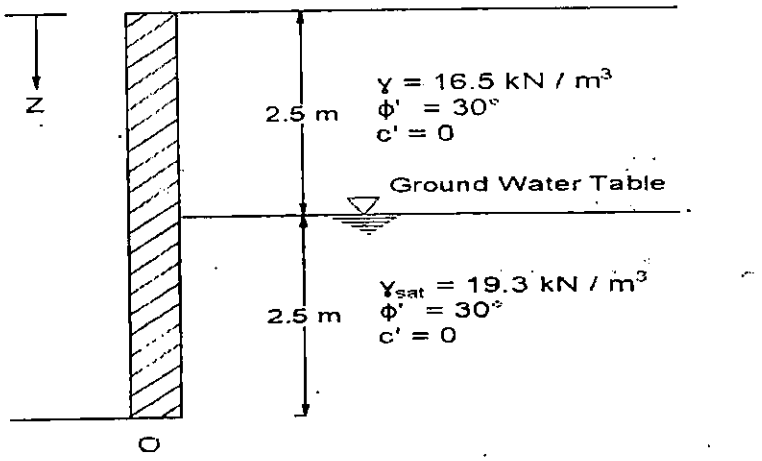
b) Design a rectangular beam for an effective simply supported span of 6.0m. The superimposed load is 80kN /m. Size of the beam is limited to 300mm x 700mm. overall. Use M20 Concrete and Fe415 grade Steel. ----------12

c) A reinforced concrete beam of rectangular section 550mm. wide and overall depth of 750 mm. It is subjected to an ultimate bending moment of 1500 kN-m and ultimate Twisting Moment of 50kN-m. M15 Grade concrete and Fe415 grade steel are used. The beam is provided with 3-20mmϕ. bars as main reinforcement at the bottom. For the beam in question, determine the transverse reinforcement required, if it carries. In addition, an ultimate shear force of 130kN. Use relevant IS code of Provisions. ------12

6. a) Describe various methods, how Bearing Capacity of Soil is determind. Also mention how Pile capacity is determined. ----------6 + 6 = 12

b) A capillary permeability test was conducted in two stages under a head of 600mm.and 1800mm. respectively, at the entry end. In the first stage, the wetted surface moved from 15mm. to 70mm in 7 minutes. In the Second stage, it advanced from 70mm. to 185mm. in 24 minutes. The degree of saturation at the end of the test was 85% and the Porosity was 35%. Determine the capillary head and Coefficient of Permeability. ----------10

c) For a retaining wall shown in figure below, determine the lateral earth force at rest per unit length of wall. Also determine the location of resultant force and also draw the pressure distribution Diagram. ----------10



Group-B

Answer any Four questions 18 x 4 = 72

7. a) What is the definition of 'Consolidation'? Write difference between Compaction and Consolidation. – (2+4)

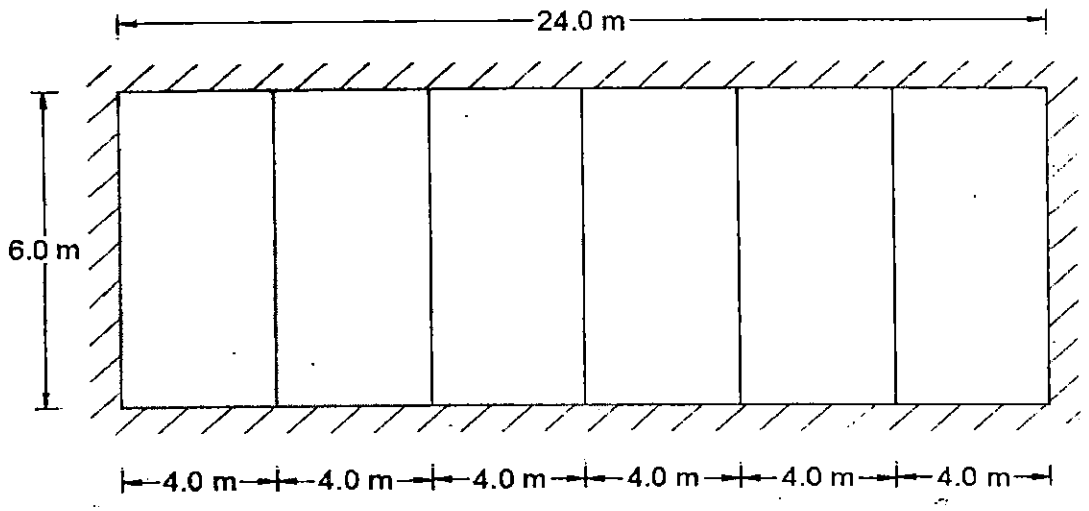
b) In a Plate bearing test on pure clayey soil failure occurred at a load of 12.2 tonnes. The size of the plate was 450mm. x 450mm. and the test was done at the depth of 1.0m. below ground level. Find out the ultimate bearing capacity for a 1.5m. wide continuous wall footing with its base at a depthof 2.0m. below the ground level. The unit weight of clay may be taken as 1.9 gm /cc and $N_c = 5.7$ and $N_q = 1$ and $N_\gamma = 0$.----------12

8. a) What is the difference between a Truss member and a Beam member. Describe in brief the steps of a Built -Up Steel Plate Girder Design. --------(2+ 4)

b) A 12mm. thick bracket plate is connected to a column flange as in the figure and transmit a Load of 80kN. Design a suitable Shop Weld connection as per the figure. Permissible stress in the weld are: In Bending – 15.45 kN / cm^2; In shear – 10.05 kN / cm^2 -------12

9. A hall 6.0m x 24 m. is to be covered with a RCC Slab and beam system. Beams are located at 4.0m. intervals and supported on 350mm thick walls alround. Live load on the roof is 2 kN / m^2 and floor finish is 0.2 kN / m^2.

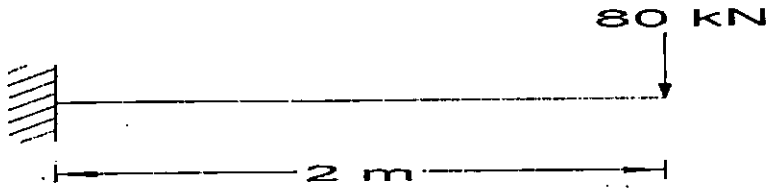
Using working stress method of design and adopting M15 Grade concrete and mild steel reinforcement, design the slab in the end panel only. ----------18



10. a) Describe Mohr's theorem. Write in brief basics of Matrix method of Analysis. 4+4

Contd...P 5

b) A cantilever beam of dimension 200mm. wide 250mm. deep projects 2.0 m. out of a wall and in carrying a point load of 80 kN at the free end as shown in figure below. Find the Slope and Deflection of the Cantilever at the free end. Consider E = 210 GPa.----10



11. a) State Castigliano's two theorems. ----------6

b) A Continuous beam is loaded as shown in Fig. below. Analyze the beam by the method of moment distribution and draw Bending Moment and Shear Force diagram. -------- 12