Roll No. .... **Total No. of Pages : 7**

1(CCEM)0

Civil Engineering

(06)

Paper—I

Time : Three Hours] [Maximum Marks : 300

Note :— (i) Answers must be written in English.

(ii) The number of marks carried by each question is indicated at the end of the question.

(iii) Part/Parts of the same question must be answered together and should not be interposed between answers to other questions.

(iv) The answer to each question or Part thereof should begin on a fresh page.

(v) Your answers should be precise and coherent.

(vi) Candidates should attempt **Q. No. 1,** which is **compulsory** and any of **THREE** of the remaining questions, selecting at least **ONE** question from each Section.

(vii) Assume missing data suitably.

(vii) If you encounter any typographical error, please read it as it appears in the text-book.

1. Answer any **THREE** of the following sub divisions, including (d), which is compulsory :

(a) Determine the vertical deflection at the force end and rotation at A in the overhanging beam shown in Fig. (1). Assume constant EI. Use Castigliano's method. 25

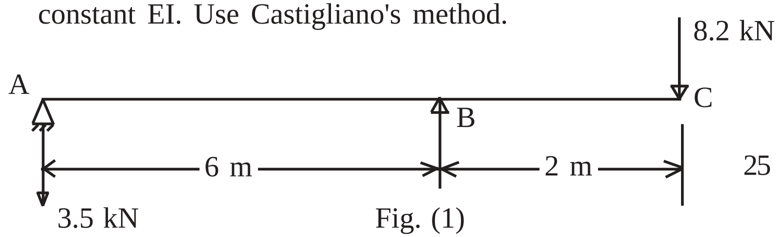

Fig. (1)

(c) Oil with free steam velocity of 2 m/sec flows over a thin plate 2 m wide and 2 m long. Calculate the boundary layer thickness and shearing stress at the trailing edge and determine the total surface resistance of the plate. Take specific gravity of oil to be 0.86 and kinematic viscosity as 10^{-5} m^2/sec. 25

SECTION–C

6. (a) Describe in brief the capillarity – permeability test. Why the values of the coefficient of permeability obtained from this test differ from those obtained from other tests ? 25

(b) A consolidated – undrained triaxial test was conducted on a saturated clay. When the confining pressure was 200 kN/m^2, the sample failed at a deviator stress of 520 kN/m^2. The pore water pressure was 140 kN/m^2. The failure plane occurred at an angle of 60^o to the horizontal. Determine the normal and shear stresses on the failure plane at failure. Also calculate the maximum shear stress. 25

(c) Design a rectangular combined footing to support two adjacent columns (size 420 mm × 420 mm) at a distance of 5m and carrying loads of 320 kN and 410 kN. The lighter column is near the property line. The allowable soil pressure is 350 kN/m^2. 25

(b) Design a suitable counter–joint retaining wall to support a level backfill, 7.5 m high above the ground level on the toe side. Assume good soil for foundation at a depth of 1.5 m below the ground level with a safe bearing capacity of 180 kN/m^2. Further assume the backfill to comprise granular soil with a unit weight of 20 kN/m^3 and an angle of shearing resistance of 30^o. Assume the coefficient of friction between soil and concrete to be 0.5. Use M_{20} grade concrete and Fe_{415} steel. 25

(c) Analyse the continuous beam shown in Fig. (2) by flexibility matrix method. Take EI constant throughout.

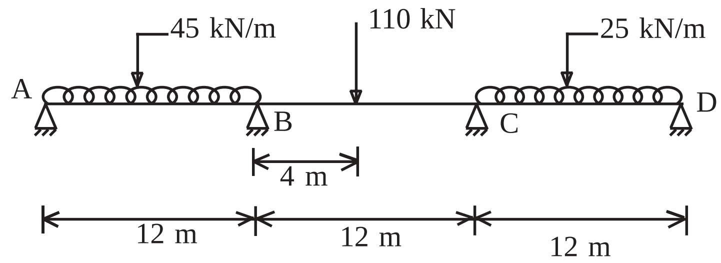

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Fig. (2)

3. (a) A riveted plate girder section is designed to carry a uniform load of 60 kN/m excluding the self-weight of the girder. In addition, the girder has to support two concentrated loads of 400 kN each at one-third points. The effective span is 18 m. The following section has been provided.

Web plate 2000 mm × 6 mm

Flange angles ISA 150 mm × 150 mm × 12 mm

(ISA 150 × 150 @ 0.272 kN/m)

Flange plates 2 Nos. 400 mm × 12 mm.

Design the bearing stiffeners to be provided at the supports and the vertical intermediate stiffeners. 25

(b) A rectangular concrete beam, 300 mm deep and 220 mm wide, is prestressed by means of fifteen 5 mm diameter wires located 65 mm from the bottom of the beam and three 5 mm wires, located 25 mm from the top of the beam. If the wires are initially tensioned to a stress of 840 N/mm^2, calculate the percentage loss of stress in steel immediately after transfer, allowing for the loss of stress due to elastic deformation of concrete only. 25

(c) Analyse the continuous beam shown in Fig. (3) by moment distribution method and draw bending moment and shear force diagrams.

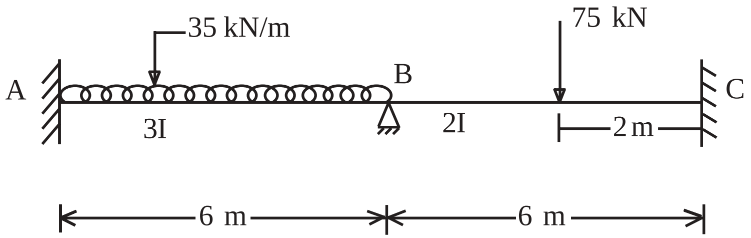

Fig. (3) 25

SECTION–B

4. (a) A venturimeter of inlet diameter 30 mm and throat diameter 150 mm is fixed in a vertical pipe line. A liquid of SP. gr. 0.8 is flowing upward through the pipe line. A differential manometer containing Mercury gives a reading of 100 mm when connected at Inlet and throat. The vertical difference between inlet and throat is 500 mm. If C_d = 0.98 then find (i) Rate of flow of liquid in litre per second and (ii) Difference of pressure between Inlet and throat in N/m^2. 25

(b) What do you mean by Prandtl mixing length theory ? Find an expression for shear stress due to Prandtl. 25

(c) A pipe of diameter 350 mm and length 1000 m connects two reservoirs, having difference of water levels as 15 m. Determine the discharge through the pipe. If an additional pipe of diameter 300 mm and length 600 m is attached to the last 600 m length of the existing pipe, find the increase in the discharge. Take f = 0.02 and neglect minor losses. 25

5. (a) (i) What are the methods of dimensional analysis ? Describe the Rayleigh's method for dimensional analysis. 10

(ii) A ship 250 m long moves in sea-water, whose density is 1030 kg/m^3; A 1 : 125 model of this ship is to be tested in wind tunnel. The velocity of air in the wind tunnel around the model is 20 m/sec and the resistance of the model is 50 N. Determine the velocity of ship in sea-water and also the resistance of the ship in sea-water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 stokes respectively. 15

(b) (i) Explain the term hydraulic Jump. Derive an expression for the depth of hydraulic Jump in terms of the up steam Froude number. 10

(ii) What is the essential difference between gradually varied flow and rapidly varied flow ? Illustrate with neatly drawn sketches. 15

(b) A simply supported beam has a span of 18 m. Uniformly distributed load of 45 kN/m and 6m long crosses the girder from left to right. Draw the influence line diagram for shear force and bending moment at a section 8m from left end. Use these diagrams to calculate the maximum shear force and bending moment at this section. 25

(c) A man is paid at the hourly rate of Rs. 31- per hour for the first 30 hours worked in a week. Thereafter the overtime is paid at 1½ times the hourly rate for the next 25 hours and 2 times the hourly rate for further hours worked. Design and write a FORTRAN program to input the number of hours worked in a week. 25

(d) Design a reinforced concrete T-beam using the following data :

Width of the rib = 250 mm

Clear span = 6 m

Beam supported on 300 mm thick walls

Spacing of beams = 3.5 m Centres

Floor-slab thickness = 120 mm

Live load on floor = 3 kN/m^2

Floor finish = 0.6 kN/m^2

Use M_{20} grade concrete and Fe_{415} steel. 25

SECTION–A

2. (a) Design a footing for a 500 × 350 mm column using 25 mm bars as dowels to transmit characteristic loads of 650 kN as dead load and 450 kN as live load to a foundation with safe bearing capacity of 120 kN/m^2. Assume M_{20} grade concrete and Fe_{415} steel. 25

7. (a) Briefly explain the Barkan method of machine foundation design. 25

(b) A retaining wall is 8 m high, with its back face smooth and vertical. It retains sand with its surface horizontal. Using Rankine's theory, determine active earth pressure at the base when the backfill is (a) Dry, (b) Saturated and (c) Submerged, with water table at the surface. Take r = 18 kN/m^3 and $\phi = 30^o$, r_{sat} = 24 kN/m^3. 25

(c) Discuss the methods for the design of :

(i) Tension piles

(ii) Inclined piles. 25