This question paper contains 8 printed pages]

HPAS (Main)—2012

CIVIL ENGINEERING

Paper I

Time : 3 *Hours* *Maximum Marks :* 150

Note :— Question No. 1 is compulsory. Attempt any *four* questions out of the remaining questions. In all *five* questions are to be attempted.

Use of the relevant Indian Standard Codes of practice and the steel sections Hand-Book is permitted.

1. (*a*) (*i*) Define unsymmetrical bending of structures. Explain on the basis of any *three* examples. 4

(*ii*) Fig. 1 shows two identical wires AO and BO each of area A and inclined at 45° to the horizontal. A load P is supported at 'O'. Find the vertical deflection of 'O' 6

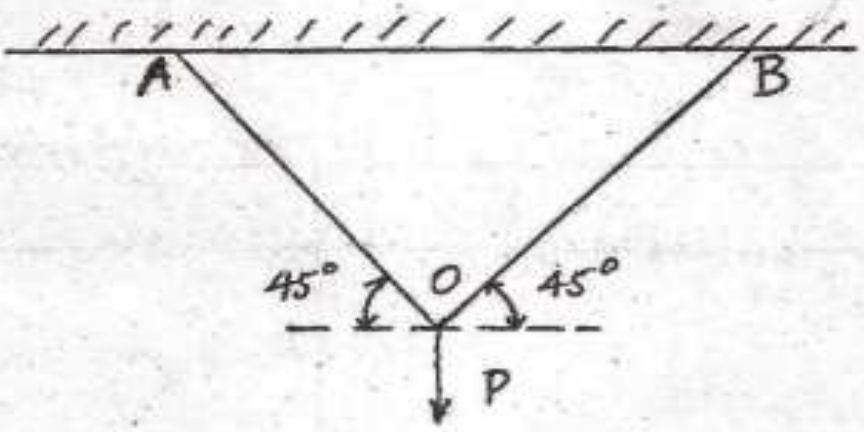

Fig. 1

P.T.O.

(b) Find the maximum value of the shear force and bending moment at any point in a simply supported beam of span 'L' due to :

(i) Concentrated load W

(ii) Uniformly distributed load W longer than the span. In both the cases the load moves on the beam from left to right. 10

(c) Explain various classifications of Hydraulic jumps. Neatly sketch the hydraulic jumps. 10

2. (a) A continuous beam ABC is supported on an elastic column BD and is loaded as shown in Fig. 2. Treating joint B as rigid analyse the frame and plot the bending moment diagram and the deflected shape of the structure. 15

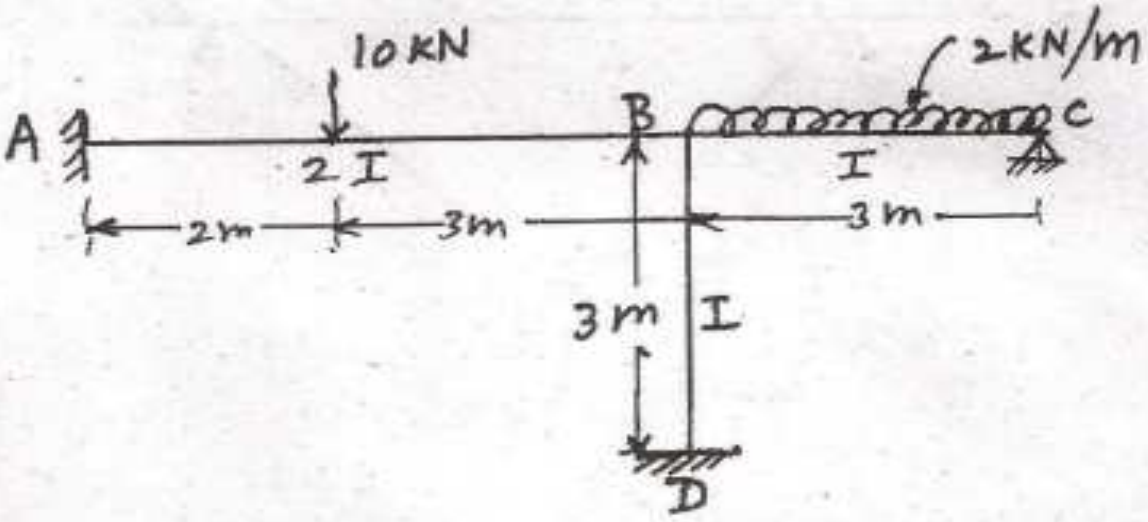

Fig. 2

(*b*) (*i*) Differentiate between moment distribution and slope deflection method of analysing indeterminate structures. 5

(*ii*) A three hinged parabolic arch as shown in Fig. 3 has a span of 20 m and central rise of 5 m. It carries a concentrated load of 80 kN at a distance of 5 m from the left support. Find the maximum bending moment and plot the bending moment diagram. 10

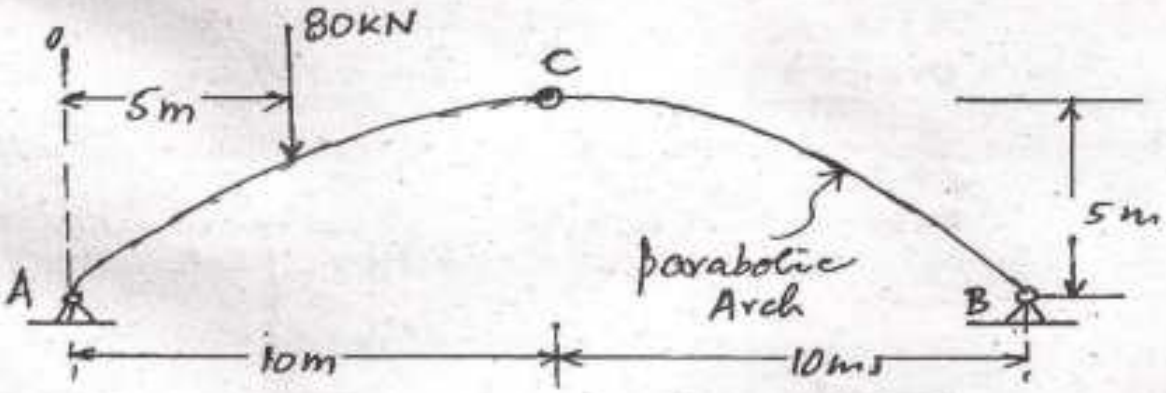

Fig. 3

P.T.O.

3. (a) (i) Design a R.C. beam subjected to a bending moment of 20 kN-m. Use M-15 concrete and mild steel reinforcement. Keep the width of the beam equal to half the effective depth. 10

(ii) Explain the term diagonal tension in R.C. structures. How do you provide reinforcement of resist failure of R.C. beams due to diagonal tension ? 5

(b) Design a short square column to carry an axial load of 1200 kN. Use M-25 concrete mix. Take σ_{SC} = 130 N/mm^2 (Compressive stress in steel). 15

4. (a) Find the section of a steel angle for a strut of 1.5 m effective length and carrying a load of 105 kN, yield stress of steel f_y = 250 MPa. 15

(b) A pipe-line carrying water has average height of irregularities projecting from the surface of the boundary of the pipe as 0.15 mm. What type of boundary is it ? The shear stress developed is 4.9 N/m^2. The kinematic viscosity of water is 0.01 stokes. 15

5. (a) A reservoir has been built 4 kilometers away from a college campus having 5000 inhabitants. Water is to be supplied from the reservoir to the campus. It is estimated that each inhabitant will consume 200 litres of water per day, and that half of the daily supply is pumped in 10 hours. Calculate the size of the supply main, if the loss of head due to friction in the pipeline is 20 m. Assume coefficient of friction for the pipeline as 0.008. 15

(*b*) The efficiency (η) of a fan depends upon density (ρ), dynamic viscosity (μ) of the fluid, angular velocity (ω), diameter (D) of the rotor and discharge (Q). Explain 'η' in terms of dimensionless parameters. 15

6. (*a*) A rectangular channel carrying a supercritical stream is to be provided with a hydraulic jump type of energy dissipator. If it is desired to have an energy loss of 5.0 m in the jump, when the inlet Froude number is 8.5, determine the sequent depths. 10

(*b*) Design a concrete lined channel to carry a discharge of 350 cumecs at a slope of 1 in 5000. The side slopes of the channel may be taken as $1\frac{1}{2} : 1$. The value of '*n*' (rugosity coeff.) for lining is 0.014. Assume limiting velocity in the channel as 2 m/sec. 20

7. (*a*) Derive an expression for the seepage discharge through an earthen dam, assuming that the dam is constructed by isotropic soil. 15

(*b*) The following are the data obtained in a shrinkage limit text :

Initial weight of saturated soil = 95.6 gm

Initial volume of the saturated soil = 68.5 cm^3

Final dry volume = 24.1 cm^3

Final dry weight = 43.5 gm

Determine the shrinkage limit, the specific gravity of grains, the initial and final dry unit weight, bulk unit weight and void ratio. 15

8. (*a*) A retaining wall with a smooth vertical back remains a purely cohesive fill. Height of the wall is 12 m. Unit weight of fill is 20 kN/m^3. Cohesion

is 1 N/cm^2. What is the total active Rankine thrust on the wall ? At what depth is the intensity of pressure zero and where does the resultant thrust act ? 15

(*b*) A 16-pile group has to be arranged in the form of a square in soft clay with uniform spacing. Neglecting end-bearing, find the optimum value of the spacing of the piles in terms of the pile diameter, assuming a shear mobilisation factor of 0.6. 15