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HPAS (Main)—2016

CIVIL ENGINEERING

Paper I

Time : 3 *Hours* *Maximum Marks* : 100

Note :— (*i*) Question No. 1 is compulsory. Attempt any *four* questions from the remaining questions. In all, *five* questions are to be attempted.

(*ii*) Use of I.S. codes of practice and the steel section Handbook is permitted.

(*iii*) Assume suitable missing data, if any.

1. (*a*) At a point in a material under stress, the resultant intensity of stress across a certain plane is 80 N/mm^2 (compressive) inclined at 30° to the

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normal. On another plane, the intensity of stress resultant is 60 N/mm^2 (tensile) inclined at 45° to the normal. Find the principal stresses and their directions to the given plane, Find also the angle between the planes. 10

(*b*) A girder 10 m long carrying a uniformly distributed load of w per metre run is to be supported on two piers so that the greatest bending moment on the girder shall be as small as possible. Find the distances of piers from the ends of the girder and maximum bending moment. Also, plot Bending Moment and Shear Force diagrams. 10

2. (*a*) A beam AB is fixed at supports A and B and carries a load which varies uniformly from 0 at supports

A & B and w kN/m at mid span. The moment of inertia of the beam is constant throughout. Determine the fixed end moments at A and B and maximum deflection. 10

(*b*) A parabolic two hinged arch has a span of 32 metres and rise of 8 m. A uniformly distributed load of 1 kN/m covers 8 m horizontal length of the left side of the arch. If $I = I_0 \sec \theta$, where θ is the inclination of the arch section to the horizontal and I_0 is the moment of inertia of the section at the crown. Find out the horizontal thrust at hinges and bending moment at 8 m from the left hinge. 10

3. (*a*) Two plates of 125 × 12 mm and 75 × 12 mm are to be joined by a lap joint. Determine the size and length of welds required to develop full strength of the smaller plate in the joint. Given f_y = 250 MPa and f_u = 410 MPa. Use Indian Standards specifications. 10

(*b*) Design and detail a bottom chord member of a highway bridge truss, carries a tensile force (working) of 1450 kN. Select a suitable built-up section for the member. Given f_y = 250 MPa and f_u = 410 MPa. 10

4. Design and detail a circular column to carry an axial load (working) of 1500 kN. The column has an effective length of 2.50 m. Use M20 concrete and Fe 415 steel. 20

5. A rectangular concrete beam of cross-section 300 mm deep and 200 mm wide, is prestressed by means of by 15 wires of 5 mm diameter located at 65 mm from the bottom of the beam and 3 wires of 5 mm at 25 mm from top. Assuming the prestress in the steel as 840 N/mm^2, calculate stress at the extreme fibres of the mid span section when the beam is supporting its own weight over a span of 6 m. If a uniformly distributed live load of 6 kN/m is imposed, evaluate the maximum working stress in concrete. The unit weight of concrete is 24 kN/m^3. 20

6. The following table gives data about durations and cost if various activities of the network are completed.

Activity	Normal Duration (Weeks)	Normal Cost (Rs.)	Crash Duration (Weeks)	Crash Cost (Rs.)
1—2	4	4000	2	12000
2—3	5	3000	2	7500
2—4	7	3600	5	6000
3—4	4	5000	2	10000

The project overhead costs are Rs. 2000 per week. Find out the optimum duration and the cost associated with it. Also, draw the least cost network. 20

7. (*a*) The moisture content of a saturated soil is 35% and relative density of its particle is 2.7. Find

the void ratio and porosity. What will be the degree of saturation and the air content if the moisture content gets reduced to 5% on drying. 10

(*b*) A specimen, 100 mm in diameter and 300 mm long, is tested in a constant head permeameter. A flow of 235 cm^3 is measured in 5 minutes when constant head difference between tapping points 200 mm apart is 65 mm. Determine the coefficient of permeability. 10

8. A raft of 20 m × 12 m is placed at depth of 2 m below the ground surface on a site where the soil profile consists of 1.5 m of fill material overlying a

deep bed of saturated clay. The bulk unit weights of the fill and clay are 18 kN/m^3 and 20 kN/m^3 respectively. The undrained unit cohesion of clay increases frorn 40 kPa at foundation level to 80 kPa at 14 m below ground surface. Determine safe bearing capacity using a factor of safety 2.5. 20