Civil Engineering
Paper-I

Time Allowed: Three Hours **Maximum Marks: 300**

Note: 1. *Candidate should answer questions No. **1** and **5** which are compulsory and any **three** of the remaining questions, selecting at least **one** from each section.*

2. *Use of IS: 456-2000, IS: 800-2007 and IS: 3370 (Part 1 & 2) - 2009 are permitted.*

SECTION – A

1. (a) A body resting on a horizontal plane required a pull of 180 N inclined at 30^0 to the plane to just move it. It was also found that a push of 220 N inclined at 30^0 to the plane just moved the body. Determine the weight of the body and the co-efficient of friction between the plane and the body. 30

(b) Determine moment of inertia of a triangle section using first principle about: 15×2=30

(i) an axis passes through the vertex and parallel to the base and,

(ii) the base.

2. Analyse the continuous beam loaded as shown in Figure-1, by Kani's method. 60

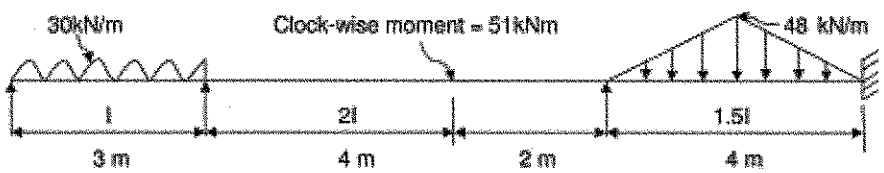

Figure-1

3. Design a welded theatre balcony plate girder for 20 m span to resist maximum factored bending moment and maximum factored shear force of 5456 kNm and 1091.2 kN respectively. Due to headroom requirement, the maximum depth of the girder is restricted to 1.1 m. The girder is subjected to uniformly distributed load and simply supported on supports. Take f_y = 250 MPa and f_u = 410 MPa.

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4. Design an open circular water tank of 400 kilolitres capacity resting on the ground. The tank wall has flexible joint with base. Use M30 grade concrete, mild steel as reinforcement and Indian Standard Specifications. 60

SECTION – B

5. A steel cylinder of 3 m diameter and 1.5 m long lies across the full width of a 1.5 m wide open channel. Water levels on left and right sides of the cylinder are 3 m and 1.5 m respectively. Determine the magnitude, location and direction of the resultant hydraulic force exerted on the cylinder. Find also the least weight of the cylinder so that it should not be lifted away from the floor of the channel.

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6. Water flows at the rate of 1 cumec along a channel of rectangular section 1.6 meters in width. Calculate the critical depth. If a standing wave occurs at a point where the upstream depth is 0.25 meter, what would be rise in the water level produced and the horse power lost in the standing wave? 60

7. A direct shear test is conducted on a medium sand specimen under the normal stress of 60 kPa. The maximum shear stress at failure is measured as 37.5 kPa. Draw the Mohr circle at failure and determine the magnitude and direction of the principal stresses in the failure zone. What is the orientation of the plane of maximum shear stress at failure? 60

8. A 2.5 m square footing is located in a dense sand at a depth of 1.5 m, the shear strength parameters being c'=0, $\Phi' = 38^0$. Determine the ultimate bearing capacity for the following water table positions: (a) at ground surface, (b) at 1 m below ground surface, (c) at footing level, (d) at 0.5 m below the footing and (e) at a depth greater than 2.5 m below the footing. The moist unit weight of sand above the water table is 18 kN/m^3 and the saturated unit weight is 20 kN/m^3. For $\Phi = 38^0$, $N_q = 48.9$, $N_\gamma = 58.9$. 60