CIVIL ENGINEERING

PAPER-I

SECTION A

1. Attempt any four of the following:

(a) A steel flat having a cross-section 6 cm x 2 cm was made into a hollow circular section such that mean perimeter of the hollow circular section is equal to 6 cm, the breadth of the strip. Find the percentage change in moment of inertia. (10)

(b) A simply supported hollow rectangular beam of outside width 200 mm, outside depth 160 mm and material thickness 20 mm is subjected to a u.d.l. of 10 kN/m for the entire span of 10 m. Find the maximum shear stress induced in the beam. (10)

(c) (i) Define an influence line. (4)

(ii) A simply supported beam of length 8 mis traversed by a system of three point loads. The loads are 2, 4 and 6 kN separated by 1 and 2 m respectively. Find the maximum bending moment at 3 m from the left-hand support by using influence line diagram. (6)

(d) Define stream function. The stream function of a flow is given as $\psi = 2x^2 - 2y^2$. Find whether the flow is rotational and calculate the velocity at the point (3, 5). (10)

(e) Two coaxial cylinders 250 mm high have a liquid in between them. The outer cylinder has an internal diameter 100 mm and the inner cylinder has an external diameter 97.5 mm. Find the viscosity of the liquid which produces at torque of 1 Nm upon the inner cylinder when the outer one rotates at 90 rpm. (10)

2. (a) A ladder of weight 200 N and length 4 m rests on a smooth vertical wall at an inclination of 30° with the horizontal floor. Find the horizontal force required at the points of contact of the legs with the floor to keep the ladder in equilibrium when a person of weight 600 N is at the centre of both the legs and at 3 m along the ladder. (10)

(b) A beam ABD hinged at A and simply supported at B has an overhang BD of 2 m and span AB of 8 m. It is subjected to a concentrated load of 18 kN at C, the central point of AB and to a concentrated load of 12 kN at the free end B. The flexural rigidity of the central half pf the span AB is 4×10^4 kN-m^2 while that of the rest of the beam is 10 kN-m^2. Find the deflection at C and D. (15)

(c) A portal frame ABCD fixed at A and D is subjected to a u.d.l. of intensity W/l along the column AB. The length of columns and the beam is 1. If the plastic moment capacity of each column is 2 Mp and that of the beam is Mp, find the collapse load by mechanism method. (15)

3. (a) A rectangular gate 2 m wide and 6 m high is hinged at the base and makes an angle of 60° with the base of the channel which is horizontal. To keep the gate in a stable position a force of 29.43 kN is applied at right angles to the plate. Find the depth of water at which the gate begins to fall neglecting the weight of the gate and friction at the hinges. (10)

(b) Design a trapezoidal channel to carry a discharge of 100 m^3/sec at a slope of 1 in 4000. The side slopes may be taken as 1:1 and the permissible velocity in the channel is limited to 2.5 m/sec. The Manning's roughness coefficient is 0.014.

(15)

(c) A Pelton wheel has a mean bucket speed of 12 m/sec and is supplied with water at the rate of 0.7 m^3/sec. The buckets deflect the jet through an angle of 160°. If the power produced is 200 kW, find the head under which the Pelton wheel operates. What is the efficiency of the turbine? Assume coefficient of velocity K_{v1} = 1.0.

(15)

4. (a) A metal pipe carrying water under a pressure of 25 MPa has an internal diameter of 200mm. If the maximum permissible tensile stress is 135 MPa, find the thickness of the pipe to withstand the pressure of water.

(15)

(b) In a rectangular channel discharging 9.28 m^3/sec per metre width, the Froude's number of the flow is 3.5. What is the velocity of flow at this Froude's number? Calculate the depths of flow before and after the formation of hydraulic jump. What is the percentage loss in specific energy?

(10)

(c) A single acting reciprocating pump has a plunger diameter of 200mm and a stroke length of 300 mm. It draws water from a sump 3.6 m below the pump centre line with a pipe 4.5 m long and 180 mm in diameter, and lifts water to a location 20 m above the pump with a pipe 25 m long and 100mm in diameter. The pump is assumed to be driven with S.H.M. If the atmospheric pressure head is 10.3 m of water and separation occurs at 2.6 m of water absolute, find the maximum operating speed of the pump.

(15)

SECTION B

5. Attempt any four of the following:

(a) A tension member consisting of two ISA 110 x 110 x 10mm is connected to the same side of a gusset plate by 20 mm diameter rivets. The angles are tack-riveted along their length and have a permissible tensile stress σ_{at} = 150 n/MM^2. Find the load carrying capacity of the member.

(10)

(b) Design a short column, square cross- section subjected to an axial load of 1500 kN (working stress). Use concrete of mix M 25 and steel of grade Fe 415. The permissible compressive stresses in concrete and steel are σ_{cc} = 6N/mm^2 and σ_{sc} = 190 N/mm2 respectively. Assume 2% steel.

(10)

(c) A masonry retaining wall, 4 m high with vertical back retains cohesionless soil having a unit weight 17 kN/m^3 and angle of internal friction 30°. The unit weight of masonry is 24 kN/m^3. If the width of the masonry wall is 1.2 m at top, find the base width to avoid tensile stresses. Use Rankine's theory for active earth pressure.

(10)

(d) A one litre capacity core-cutter of mass 1 kg was pushed into an embankment under construction and the mass of the core-cutter with soil was found to be 2.865 kg. If the soil had a water content of 11% and specific gravity of soil solids is 2.67, determine the bulk unit weight, dry unit weight, void ratio and degree of saturation of the soil sample. The unit weight of water is 9.81 kN/m^3.

(10)

(e) The top layer of a soil deposit consists of a clay layer of 4 m thickness overlying a very thick layer of sand. Even though the water table is at the middle of the clay layer, the clay soil above the water table is saturated. The water content of clay strata is 30% while, that of sand strata is 26%. If the specific gravity of clay and sand are 2.72 and 2.64 respectively, calculate the total stress, pore water pressure and effective stress at a depth 8m from the ground surface.

(10)

6. (a) A laterally supported beam consisting of ISMB 600 @ 1.2 kN/m is simply supported over a span of 8.5 m. If allowable sheat stress τ_{va} = 100 N/mm^2, bending stress $\sigma_{bt} = \sigma_{bc}$ = 165 N/mm^2, allowable deflection = span/325 and E = 2 x 10^5 N/mm^2, find the safe u.d.l. that the beam can carry. The properties of I-section are : I_{xx} = 91813 cm^4, Z_{xx} = 3060.4 cm^3, h = 600 mm, b = 210 mm, t_w = 12.0 mm, t_f = 20.8 mm.

(15)

(b) A P-beam has flange width of 740 mm, flange thickness of 85 mm, web thickness of 240 mm and effective depth of 400 mm. Find the area of steel if the applied ultimate moment is 186 kNm. Take f_{ck} = 15 N/mm^2 and f_y = 250 N/mm^2.

(15)

(c) A column 400 mm x 400 mm carries an axial load of 800 kN. It is provided with a uniform thick R.C.C. footing. Find the depth of the footing to resist shearing action only. The bearing capacity of soil is 100 kN/m^2. Use f_{ck} = 15 N/mm^2 and $\tau_c = 0.16\sqrt{f_{ck}}$

(10)

7. (a) A layer of normally loaded clay is 7 m thick and lies under a recently constructed building. The weight of sand overlying the clay layer is 300 kN/m^2 and new construction increases the overburden pressure by 100 kN/m^2. The clay has a natural water content of 45% and specific gravity of 2.7, and is submerged with the water table being at the top level of the clay strata. Assuming compression index to be 0.5, compute the final settlement.

(10)

(b) An anchored sheet pile supports a sandy backfill of height 3 m, having angle of shearing resistance of 30° and unit weight of 19 kN/m^3. The soil below the dredge line is clay with a unit weight of 19 kN/m^3, cohesion 20 kN/m^2 and zero angle of internal resistance. The anchor rods are placed 1 m apart and 1 m below the level surface of the backfill. Assuming free earth support, calculate the force in the anchor and the depth of the sheet pile. Use Rankines' theory for earth pressure.

(15)

(c) A 8 m long pile is used in a deposit of uniform clay having unconfined compressive strength of 100 kN/m^2 and adhesion factor of 0.9. If the pile has to carry an axial load of 60 kN with a factor of safety of 4, find the diameter of the pile. Take N_c =9.

(15)

8. (a) A rectangular concrete beam 200 mm wide and 300 mm deep is prestressed by 15 wires of 5 mm diameter located at 65 mm from the bottom of the beam and 3 wires of 5 mm diameter located at 25mm from the top. Assuming prestress in the steel as 840 N/mm^2, calculate the

stresses at the extreme fibres of the mid-span section when the beam is supporting its own weight over a simply supported span of 6 m. If a u.d.l. of intensity 6 kN/m is superimposed, evaluate maximum working stresses in concrete. Assume no loss in prestressing and self-weight to be 25 kN/m^3.

(10)

(b) Design a bracket connection to the flange of an I-section ISHB 250 having flange thickness 9.7 mm and flange width 250 mm to carry a load of 100 kN at an eccentricity of 300 mm. Use 220 ϕ rivets. The flange face and bracket plate surface touch each other. Assume τ_{vf} = 100 N/mm^2 and τ_{pf} = 300 N/mm$_2$.

(15)

(c) A direct shear box test on a specimen of sand gave the following observation

Normal stress : 100 kN/m^2

Shearing stress : 46.6 kN/m^2

Determine the angle of internal friction, and the shear strength of this soil at 5 m from the round surface. Assume specific gravity of the solids as 2.65 and void ratio as 0.7. The round water table is at a depth of 2 m from the ground surface. Also find the change in shear strength when water table rises upto the ground level.

(15)

CIVIL ENGINEERING

PAPER-II

SECTION A

1. Answer any four parts:

(a) Describe the components, properties and uses of

(i) Air entraining cement.

(ii) Water repellent cement.

(10)

(b) Briefly describe a scraper.

(10)

(c) What is a tacheometer? What are the methods of tacheometry?

(10)

(d) Define tonnage rating of a locomotive and state how it varies with the temperature.

(10)

(e) Briefly describe factors which are considered in the planning and decision-making processes for a highway.

(10)

2. (a) The tangents to a railway curve meet at an angle of 120°. Owing to the position of a building a curve is to be chosen which will pass near a point A, 20 m from the point of intersection of the tangents on the bisector of the angle 120°. Find to the nearest half degree, the degree of a suitable curve, and then calculate the tangent distances and show how near this curve passes to A.

(15)

(b) Using the Prismoidal formula, find the volume of a tank which is excavated in level ground to a depth of 3 m. The top of which is rectangular in shape, has an area of 20 m x 5m, while the bottom is 1 m x 2 m.

(15)

(c) Describe the triangle of error method in solving a three-point problem, and while stating the Lehmann rules, stress upon their need.

(10)

3. (a) List the various uses of timber as a construction material and discuss the advantages and disadvantages of using timber for each of the above.

(12)

(b) Discuss the causes and remedies of timber decay.

(8)

(c) With sketches, briefly describe the vermiculated finish, polished finish, scabling, combed finish and moulded finish for stone masonry work.

(10)

(d) Giving a neat sketch, describe a Jack Arch floor.

(10)

4. (a) In a reverse curve given the perpendicular distance p between parallel tangents, the chord distance d between point of curvature and point of tangency; and on radius R_1 of a reversed curve, derive an expression for the second radius R_2.

(12)

(b) Discuss the various functions performed by the Ballast.

(8)

(c) Discuss the basis on which the highways are classified (for purposes of geometric design rather than the structural design), and explain (with examples) how a class is designated.

(10)

(d) Describe the term High-mast lighting and its advantages.

(10)

SECTION B

5. Answer any four parts:

(a) Write a note on stream channel routing.

(10)

(b) Briefly describe the various methods of training of rivers.

(10)

(c) Derive an expression for the correction in flow when using the Hardy-Cross method of analysis of flow in a reticulated pipe network.

(10)

(d) Write a small note on sanitary landfill.

(10)

(e) Write a note on consent granted by pollution control boards to the various industries.

(10)

6 (a) Briefly describe the situations when a water resource project will have significant effects on the environment.

(15)

(b) Write a brief note on the entry of impurities in irrigation waters.

(10)

(c) Discuss the various factors affecting irrigation requirements.

(15)

7. (a) Design the size and number of units of rapid sand filters for a town with the following data:

Average quantity of water required per capita: 150 lpd
Population served : 50,000
Seasonal variation factor: 2.0
Hourly variation factor: 2.9
Rate of filtration: 150,000 $l/m^2/d$
Backwash time : 30 min/d

(15)

(b) For and daily water supply of 1 106 1, determine the amount of daily bleaching powder (having available chlorine of only 20%), if the water's chlorine demand is 1.0 mg/l which leaves a residual chlorine of 0.3 mg/l after 40 mm of contact time.

(10)

(c) Design a rectangular grit chamber for a sewage flow rate of 40 mld containing grit particles of specific gravity 2.65 and size 0.2 mm to be removed. Determine the setting velocity of the 0.2 mm grit particles, critical horizontal velocity of flow (just below the velocity of scour) and the size of the grit chamber (assuming a detention time of45 sec). Assume- the kinematic viscocity as 1.0×10^{-2} cm^2/sec.

(15)

8. (a) Assuming the initial infiltration rate (f_0) as 10 mm/h, final infiltration rate (f_c) as 5 mm/h, and k (a constant describing the rate of decay of the difference between initial and final infiltration rates) as 0.95 h^{-1}, calculate the total infiltration depth (F) for a storm lasting 2 h.

(12)

(b) Calculate the diameter of a circular sewer carrying 0.624 m^3/s of sewage when flowing full at a slope of 1 in 1000. Take n (in Manning's formula) as 0.012. For this sewer, if the flow were at 0.4 depth, what would be the discharge and velocity in the sewer at the depth? Given that at d/D of 0.4, q/Q is 0.32 and u/V is 0.88.

(12)

(c) Describe one method forth" safe disposal of radioactive waste.

(8)

(d) Discuss the impact of acid mine drainage on a aquatic system.

(8)