CIVIL ENGINEERING (Paper - III)

Time allowed : 3 Hours } **{ Maximum Marks : 200**

Note :

(i) Solve any one question from each section.

(ii) Do not reproduce any question. Write only the question number against the answer.

(iii) Number of optional questions up to the prescribed number in the order in which questions have been solved, will only be assessed, excess answers of the question/s will not be assessed.

(iv) Figures to the right indicate the marks for the questions.

(v) Assume suitable data if necessary and state it clearly.

(vi) Use of Non-programmable calculators is permitted.

*(vii) Use of I.S. Codes and Steel Tables is **not** permitted.*

(viii) Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer books otherwise they will be penalised.

(ix) Candidates are expected to answer all the subquestions of a question together. If subquestion of a question is attempted elsewhere (after leaving a few pages or after attempting another question) the later subquestion shall be overlooked.

SECTION - A

1. (a) Differentiate between cohesion and adhesion by giving one example for each. **10**
Two capillary tubes of diameter 1.50 mm and 3 mm are dipped in oil of surface tension 0.036 N/m and specific weight 9300 N/m^3. Find the difference of oil levels in the two tubes. Assume contact angle of 25°.

(b) List and briefly explain the limitations of Bernoulli's theorem. **10**
The diameter of a vertical tapering pipe at sections A and B, 1.5 m apart are 150 mm and 75 mm respectively. Section A is higher than section B. For a certain discharge of water down the pipe, the pressure head at B is greater than pressure head at A by 0.5 m and the loss of head between the two sections is h_L. When the same quantity of water flows up the pipe the pressure head at B is greater than pressure head at A by 0.8 m and the loss of head between the sections is found to be $2h_L$. Find the value of this discharge . What is the value of h_L ?

P.T.O.

(c) Explain the significance of Reynold's Number in pipe flow. **10**

A spillway model is to be built to a geometrically similar scale of 1/50 across a flume of 60 cm width. The prototype is 15 metres high and maximum head on spillway is expected to be 1.5 m. If the flow over a model at a particular head is 12 litres per second, what flow per metre length of the prototype is expected ?

(d) List the criteria on which turbines are classified. Also differentiate between reaction and impulse turbine. **10**

A centrifugal pump delivers water against the net head of 14.5 metres and at a design speed of 1000 rpm. The vanes are carried back at an angle of 30° along the periphery. The impeller diameter is 300 mm and the outlet width is 50 mm. Determine the discharge of the pump if the manometric efficiency is 95%.

2. (a) Explain the conditions required for stable, unstable and neutral equilibrium of a floating body. **10**

The velocity components in a two dimensional flow field for an incompressible fluid are as follows.

$$u = \frac{y^3}{3} + 2x - x^2 y, \qquad v = xy^2 - 2y - \frac{x^3}{3}$$

Obtain an expression for the stream function ψ.

(b) Explain the concept of 'Most economical channel section'. State the conditions required for rectangular and trapezoidal channel sections to be most economical. **10**

Water flows through 150 mm diameter pipe AB 400 m long. The point B is 20 m above A. The discharge through the pipe is 0.02 m^3/sec from A to B. Find the pressure at A if the pressure at B is 200 kPa. Take f = 0.006.

(c) What is the cause of boundary layer separation ? Briefly explain any one method of avoiding boundary layer separation **10**

A 400 mm diameter concrete pipe 4100 m long conveys water at the rate of 10000 m^3 per day. If the pipeline is gradually closed by a valve at the downstream end in an interval of 15 seconds, show that there is a risk of pipe burst. Assume test pressure of concrete pipe as 25 m of water.

(d) With a neat sketch show the general layout and section of a high head hydroelectric power house. Also name the components. **10**

A single acting reciprocating pump, with one cylinder has the following characteristics : Diameter of cylinder 20 cm, stroke length 40 cm, discharge 6 litre/sec, suction head 4 m, delivery head 20 m, rpm 30.

Find the energy required to drive the pump.

SECTION - B

3. (a) Enumerate the different types of rain gauges and describe with a neat sketch the construction and function of the non-recording type of rain gauge. **10**

(b) What is meant by 'stream gauging' ? Describe the velocity area method used for stream gauging. **10**

(c) A loam soil has a field capacity of 25 percent and wilting coefficient of 10 percent. The dry unit weight of soil is 1.5 g/cc. If the root zone depth is 60 cm, determine the storage capacity of the soil. Irrigation water is applied when moisture content falls to 15 percent. If the water application efficiency is 75 percent, determine the water depth required to be applied in the field. **10**

(d) A 0.5 m diameter gravity well is being pumped at a steady rate of 1500 lit/minute. The drawdown of 6 m and 2 m was observed in nearby test wells at distances of 6 m and 16 m from the well being pumped after a steady state is reached. Assume the well to be fully penetrating. The bottom of the well is 100 m below the undisturbed ground water table. Assuming that all observed points lie on Dupuit's curve compute the drawdown in the well being pumped. **10**

4. (a) What are the different types of cross drainage works that are necessary on a canal alignment ? State briefly the conditions under which each one is used. **10**

(b) What are the different methods of reducing seepage in earth dams ? Explain with sketches. **10**

P.T.O.

(c) The average rainfall values over a catchment in three successive 2-hour intervals are 3, 5 and 2 cm, respectively. The ϕ index for the catchment is taken as 0.2 cm/hour. The 2 hour unit hydrograph ordinates are given in table below. **10**

Time in Hrs.	0	2	4	6	8	10	12	14	16
Discharge m^3/sec	0	10	40	70	50	20	10	6	0

Base flow can be taken as 7 m^3/sec at the beginning of the storm linearly increasing to 9 m^3/sec at 10 Hrs. after the beginning and then linearly decreasing to 8 m^3/sec at 4 Hrs. after the end of direct run off. Compute the resultant flood hydrograph.

(d) What are the principal causes and effects of water logging in a canal irrigated farm ? What precautions will you adopt to prevent water logging ? **10**

SECTION - C

5. (a) Discuss the method of conducting CBR test in a laboratory. How will you apply the correction to load penetration curve ? What will be the effect of lateral confinement on CBR value ? **10**

(b) Write short notes on :

(i) Equivalent single wheel load **5**

(ii) Equivalent load factor **5**

(c) Why extra widening needs to be provided on a horizontal curve ? **10**

Calculate the total width of pavement on horizontal curve for National Highway in plain area with a ruling minimum radius. Use following data for the design :

Design speed = 100 km/hr

Pavement width on straight portion = 7.0 m

Number of lanes = 2.

Wheel base of truck = 6.10 m.

Ruling minimum radius = 360 m

(d) What is camber ? Discuss different types of camber and its limiting value for different Road types. **10**

6. (a) Discuss the classification of subgrade soils as per revised PRA system of soil classification. **10**

(b) Design the flexible pavement section as per IRC-37-2001 for 1300 commercial vehicles per day. The rate of growth of traffic is 8% and three year's are required for construction of pavement after last count. **10**

Assume CBR value of subgrade soil = 5%

Lane distribution factor = 0.75

Traffic intensity msa	CBR = 5%			
	total pavement thickness	Pavement composition		
		BC (mm)	DBM (mm)	Granular Base and Subbase
10	660	40	70	
20	690	40	100	Base = 250 mm
30	710	40	120	
50	730	40	140	Subbase = 300 mm
100	750	50	150	
150	770	50	170	

(c) What is super elevation ? Why is it required to provide on horizontal curve ? Derive the expression for equilibrium super elevation. **10**

(d) The speeds of overtaking and overtaken vehicle are 80 km/hr and 50 km/hr respectively on two lane road. If the acceleration of overtaking vehicle is 3.6 km/hr/sec. Calculate **10**

(i) Safe overtaking sight distance

(ii) Minimum length of overtaking zone

(iii) Desirable length of overtaking zone

(iv) Draw a neat sketch showing overtaking zone and position of sign post.

P.T.O.

SECTION - D

7. (a) What are various characteristics of an ideal site for a bridge across a river. **10**
The maximum flood discharge under a bridge is 4775 m^3/s. If the normal width and waterway are 960 and 900 m respectively. Find out the scour depth and afflux. The bridge is located in a moderate bend and the Lacey's silt factor is 1.0 velocity of approach is 2 m/s and coefficient of discharge C = 0.9, K=1.5.

(b) Enlist the various loads, forces and stresses considered while designing bridges. **10**
Explain briefly the traffic aspects of highway bridges.

(c) Explain briefly with neat sketches various shapes of tunnel. **10**

(d) What are the various methods of tunnelling in soft ground ? Explain with neat sketches. **10**

8. (a) Define Afflux and write Merriman's and Molesworth's formula for determination of afflux. **10**

The catchment area of a river is 12000 ha. The length of the catchment area is 24 kms and the fall in level from critical point to the bridge is 168 mts. The soil of the catchment is loamy with light covered vegetation cover. Find the peak runoff to design a bridge, if the severest storm yielded 20 cm of rain in 5 hrs. Coefficient for losses due to absorption and rainfall are 0.4 and 0.7 respectively.

(b) Explain various methods of erection of steel girder bridges with neat sketches. **10**

(c) What do you mean by ventilation of tunnel ? Explain various methods of tunnel ventilation **10**

(d) What is mucking ? Enlist the equipment used for this purpose. **10**
Explain various types of permanent drainage systems in tunnel.

SECTION - E

9. (a) Draw a neat sketch and explain Tube settler. What are the advantages of tube settler over plain sedimentation. **10**

Design tube settler module of square cross section for following data :

(i) Average output required from tube settler = 250 m^3/hr.

(ii) Loss of water in desludging = 2% of output required.

(iii) Cross section of square tubes = 50 mm × 50 mm

(iv) Length of tubes = 1 m

(v) Angle of inclination of tubes = 60%

(b) (i) Explain the following sewer appurtenances with a neat sketch **6**

(A) Inverted Syphon

(B) Drop Manhole

(ii) Calculate the diameter and discharge of a circular sewer which is half full and laid down at a gradient 1 in 400 running with velocity of 1.9 m/s (Take n = 0.012) **4**

(c) What is activated sludge process for waste water treatment ? What are the modifications of Activated Sludge Process. **10**

The average operating data for a conventional activated sludge treatment is as follows :

(i) Sewage Flow = 50,000 m^3/day

(ii) Volume of aeration tank = 16,000 m^3

(iii) Influent BOD = 250 mg/lt

(iv) Effluent BOD = 30 mg/lt

(v) MLSS conc. = 2500 mg/lt

(vi) Effluent suspended solids = 40 mg/lt

(vii) Waste sludge suspended solids = 12,000 mg/lt

(viii) Quantity of waste sludge = 250 m^3/day

Determine :

(A) Aeration period in hours.

(B) F/M Ratio

(C) Percentage efficiency of BOD removal

(D) Sludge age.

(d) (i) What is meant by primary and secondary pollutants in Air pollution. 5

Give the examples of these pollutants.

(ii) Explain Ambient Air Quality standards with respect to noise as per the Noise Pollution Rules, 2000. Also explain various terms in it. 5

10. (a) What is meant by disinfection ? 10

Enlist the various methods of disinfection. Explain chlorine as a disinfectant with the reactions.

What is Breakpoint chlorination ? Explain breakpoint chlorination with graph.

(b) Explain with a neat sketch D.O. Sag curve. State the equation to find out critical D.O.deficit in the stream. Explain the various terms in the equation. 10

A stream is having a flow of 1 m^3/sec and BOD 4 mg/lt is saturated with D.O. It receives an effluent discharge of 0.25 m^3/sec having BOD 20 mg/lt and D.O. 4 mg/lt. If the average velocity of flow is 0.15 m/sec. Calculate D.O. deficit at points 20 km and 40 km downstream. Assume that the temperature is 20°C throughout and BOD is measured at 5 days. Take rate constants for effluent and stream as 0.12 and 0.30 per day respectively.

Saturation D.O. at 20°C is 9.17 mg/lt.

(c) (i) What is meant by Inversion ? 5

What are the various types of inversions, occurring in nature ?

(ii) Draw a neat sketch and explain the working of electrostatic precipitator. 5

(d) What are the various methods of Landfilling of Municipal Solid Waste ? 10

Explain these methods.

What are the various ways to avoid ground water contamination due to leachate coming out from landfill site.

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