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Paper Code : CE-701

PUID : 07221 (To be mentioned in the main answer script)

ENVIRONMENTAL ENGINEERING

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own

words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the

   following :   10 × 1 = 10

   i)   Sewage treatment plants are normally designed for

        a design period of

        a)   40-50 years

        b)   30-40 years

        c)   15-20 years

        d)   5-10 years.

   ii) When fluoride concentration in exceeds 1.5mg/1 or

        so, the disease that may caused is

        a)   Methemoglobinemia

        b)   Fluorosis

        c)   Dental caries in children

        d)   Poliomyelitis.

   iii) Expression for settling velocity for a sedimentation

        tank is given by :

        a)   Q/BH   b)   Q/BL

        c)   Q/LH   d)   none of these.

   iv) A manhole is generally classified as a deep

        manhole, if its depth is less than

        a)   0.9 m   b)   1.2m

        c)   1.5m   d)   2 m.

   v)   The total water requirement of a city is generally

        assessed on the basis of

        a)   Maximum hourly demand

        b)   Maximum daily demand+ fire demand

        c)   Average daily demand + fire demand

        d)   Greater of (a) and (b).

   vi) Water sample has pH value of 9.00. The

        concentration of OH ion in the water sample is

        a) 10^{-9} moles/L   b) 10^{-5} moles/L

        c)   0·17 mg/L   d)   1·7 mg/L.

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vii) As per IS- 10500:2012, the safe permissible limit of Arsenic in potable water is

a) 0.01mg/L

b) 0.05mg/L

c) 10mg/L

d) both of (a) and (c).

viii) Criterion for particles to be removed completely in a sedimentation tank is given by :

a) $v_s \geq Q/BL$

b) $v_s < Q/BL$

c) $v_s > Q/LH$

d) none of these.

ix) The flow velocity in a sewer does not depend on :

a) its grade

b) its length

c) its hydraulic mean depth

d) its roughness.

x) The nitrogenous demand begins after how many days ?

a) 3

b) 4

c) 5

d) 10.

xi) Distribution mains of any water supply, is normally designed for its average daily requirement

a) 100%

b) 150%

c) 200%

d) 225%.

xii) The efficiency of sedimentation tank does not depend upon

a) detention time

b) depth of the tank

c) length of the tank

d) horizontal velocity of water.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. Explain what you mean by Self-cleansing velocity and Non-scouring velocity for a sewer pipe.

3. Find the terminal velocity (up to trial two) of a spherical particle with diameter 0.5mm and specific gravity of 2.65 settling through water at 20°C. Assume $\omega = 998.2 kg/m^3$ and $\mu = 1.002 \times 10^{-3} N\text{-}s/m^2$ at 20°C. http://www.makaut.com

4. A 60 cm diameter well is being pumped at a rate of 1450 litres/minute. Measurement in a nearby test well were made at the same time as follows. At a distance of 6 m from the well being pumped, the drawdown was 7 m, and at 15 m, the drawdown was 2.5 m. The bottom of the well is 100 m below the ground water table.

a) Find out the coefficient of permeability.

b) If all the observed pts. were on the Dupuit curve, what was the drawdown in the well during pumping ?

c) What is the sp. capacity of the well ?

d) What is the maximum rate at which water can be drawn from this well ?

5. If 20 ml of raw sewage has been diluted to 500 ml and DOi of the diluted sample was 15 mg/l, and it was 10 mg/l after 5 days incubation at 20°C, then find the COD of the raw sewage with respect to its BOD^5.

6. For a city, population 5 lacs, find the following in connection with the water supply

a) Average daily demand

b) Max daily demand

c) Peak demand

d) Fire demand.

Assume avg. water consumption 230 lpcd.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. A city with a population of 1 crore has to be supplied with water at 250 litres per person per day. The probable hourly variation in the rate of demand is given in the given table :

Period of day in hours (1)	Percentage of average hourly flow expected (2)
0-1	22.5
1-2	22.5
2-3	22.5
3-4	30
4-5	37.5
5-6	60
6-7	120
7-8	180
8-9	270
9-10	330
10-11	330
11-12	225
12-13	150
13-14	120
14-15	90
15-16	165
16-17	225
17-18	270
18-19	270
19-20	240
20-21	210
21-22	120
22-23	67.5
23-24	22.5

Determine the capacity of the balancing reservoir to be provided for balancing the variable demand against a constant rate of pumping,

a) if the pumping is to be done for all the 24 hours.

b) if the pumping is to be done only from 5 A.M. to 11 A.M. and 2 P.M. to 8 P.M. Also mention the rate of pumping required in both cases. Solve this problem by using, (i) mass curve method, (ii) analytical method.

8. a) State the design parameters considered to design a aeration tank for an activated sludge process.

   b) An average operating data for conventional activated sludge treatment plant is given below :

   i)   waste water flow = 50000 m^3/d

   ii) volume of aeration tank = 15500 m^3

   iii) influent and effluent BOD are 200mg/l and 25 mg/l respectively

   iv) mix liquor suspended solid (MLSS)= 3000 mg/l

   v)   effluent suspended solids= 40 mg/l

   vi) waste sludge suspended solids= 12000 mg/l

   vii) quantity of waste sludge = 250 m^3/d.

   Based on the above determine :

   i)   aeration period (hrs)

   ii) food to microorganism ratio (kg BOD per day/ kg MLSS

   iii) percentage efficiency of BOD removal

   iv) sludge age in days.

9. a) What is meant by coagulation? What are the common coagulants used? Describe the chemical reactions involved and indicate the formulas (or equations) for chemical reactions the flocs that form. Explain the reactions by stages if any.

   b) A coagulation-sedimentation plant clarifies 50 million liters of water every day. The quantity of filter alum required at the plant is 20 mg/litre. If the raw water is having alkalinity equivalent to 5 mg/litre of $CaCO_3$. Determine the quantity of filter alum and the quick lime (containing 85% of CaO) required per year by the plant. Given the molecular weight as [Al = 27, S = 32, O = 16, H = 1, Ca = 40, C = 12]   (1 + 1 + 5 + 2) + 6

10. a) State the conventional flow chart of a sewage treatment plant for treating municipal sewage showing all the details.

    b) Design a grit chamber for a maximum waste water flow of 8000 m^3/d to remove particles upto 0.2mm dia having specific gravity of 2.65. Settling velocities of these particles range from 0.018 to 0.022 m/sec. Maintain a constant flow through velocity of 0.3 m/sec using a proportional flow weir.   5 + 10

11. Write short notes on any three of the following :   3 × 5

    a) Activated Sludge Process

    b) Dead End System

    c) Oxidation Ditch

    d) Break Point Chlorination

    e) Grit Chamber.