

- (viii) Free available chlorine is
 (a) OCl⁻ (b) HOCL
 (c) OCl⁻ + HOCL (d) Ca(OCl)₂
- (ix) Aerobic bacteria
 (a) flourish in the presence of free oxygen
 (b) stabilize organic matter in sewage
 (c) consume organic matter as their food
 (d) all the above.
- (x) Hydraulic mean radius is
 (a) mean of radii in a pipe line of varying cross-section.
 (b) mean radius of sewer.
 (c) difference in heads between two points in circular pipes
 (d) cross-sectional area/wetted perimeter.

Group - B

2. (a) Explain the significance of the following from the point of view of water quality criteria: (i) Turbidity (ii) Chloride (iii) Nitrates (iv) Sulphates.
 (b) Explain the significance of E-coli in water analysis. **8 + 4 = 12**
3. (a) A 200 ml sample of water has initial pH of 10.30 ml of 0.02 (N) H₂SO₄ is required to titrate the sample to fall the pH to 4.5. If OH⁻ concentration is 5 mg/L as CaCO₃ and 11 ml of 0.02 (N) H₂SO₄ is consumed to reach pH from original to 8.3, then find the concentration of different alkalinity causing species.
 (b) In a water treatment plant the pH values of incoming and outgoing waters are 9.00 and 12.5 respectively. Assuming a linear variation of pH with time, determine the average pH value of water. **7 + 5 = 12**

Group - C

4. (a) Draw the flowchart showing the different process of water treatment.
 (b) In a coagulation basin 8 mg of copperas (FeSO₄ . 7H₂O) is consumed with lime(CaO), per litre water. Determine the quantity of copperas and the quick lime required to treat 10 million litres of water. **6 + 6 = 12**

5. (a) Calculate the head losses and the corrected flows in the various of a distribution network shown in figure 1. The diameters and lengths of the pipes used are given against each pipe. Make a Hardy-Cross method with William Hazen's formula, compute corrected flows after two corrections.

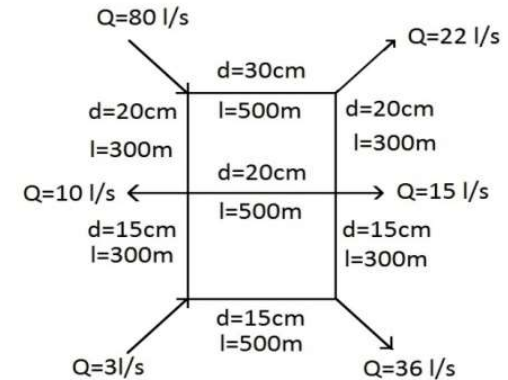


Figure 1

- (b) Describe dead end system of distribution with advantages and disadvantages. Describe grid iron system of distribution advantages and disadvantages. **8 + 4**

Group - D

6. (a) Determine the size of a circular sewer for a discharge of 60 running half full. Assume S = 0.0001 and n = 0.015.
 (b) Calculate the velocity and discharge through a rectangular lined smooth channel 2.4 m wide and 1.2 m deep built to a slope of 1 in 200, when running completely full. Use Bazin's coefficient in C formula as: $C = \frac{157.6}{1.81 + (k/\sqrt{R})}$ where k = 0.3 for smooth concrete lined surface. **6 + 6**
7. A 350 mm diameter sewer is to flow at 0.35 m depth on a ensuring a degree of self-cleansing equivalent to that obtained depth at a velocity of 0.8 m/sec. Find:
 (i) The required grade
 (ii) Associated velocity
 (iii) The rate of discharge at this depth.

Given:

- (i) Manning's rugosity coefficient = 0.014;
- (ii) Proportionate area = 0.315
- (iii) Proportionate wetted perimeter = 0.472
- (iv) Proportionate HMD (r/R) = 0.7705.

12

Group – E

8. (a) Define Biochemical Oxygen Demand. Calculate 1 day BOD of sewage sample whose 5 day 20°C BOD is 100mg/l. (Assume K_D at 20°C as 0.1.)
- (b) Describe physical, chemical characteristics of wastewater. Describe second stage BOD.

6 + 6 = 12

9. (a) Describe the trickling filter. Describe the biological processes in a trickling filter.
- (b) The sewage flows from a primary sedimentation tank to a standard rate trickling filter at a rate of 5 million litre per day having a 5 day B.O.D. of 150 mg/l. Determine the depth & volume of the filter, adopting surface loading of 2500 l/m²/day & an organic loading of 165g/m³/day. Also determine the efficiency of the filter unit, using NRC formula.

7 + (3 + 2) = 12

**ENVIRONMENTAL ENGINEERING
(CIVL 3104)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: 10 × 1 = 10
- (i) As per IS: 1172–1993, for an average Indian town, the total water demand is taken as
- | | |
|-------------|--------------|
| (a) 135lpcd | (b) 200lpcd |
| (c) 235lpcd | (d) 335lpcd. |
- (ii) The maximum daily water demand when added to the fire demand gives
- | | |
|---------------------------|-------------------------------|
| (a) Maximum Hourly Demand | (b) Average Daily Demand |
| (c) Coincident Draft | (d) 2 × Average daily demand. |
- (iii) Alum forms effective flocs in the pH range of
- | | |
|----------------|------------------|
| (a) 5.5 to 7.3 | (b) 6.5 to 8.5 |
| (c) 7.5 to 9.3 | (d) 9.4 to 10.0. |
- (iv) Which of the following method gives higher projected population?
- | | |
|---------------------------------|-------------------------------|
| (a) Incremental Increase Method | (b) Geometric Increase Method |
| (c) Arithmetic Increase Method | (d) All gives same value. |
- (v) Removal of oil and grease from sewage, is known
- | | |
|---------------|--------------------|
| (a) Skimming | (b) Filtration |
| (c) Screening | (d) Sedimentation. |
- (vi) The recommended detention period for grit chamber is
- | | |
|---------------|---------------|
| (a) 5 minutes | (b) 3 minutes |
| (c) 2 minutes | (d) 1 minute. |
- (vii) Permissible limit of chromium in drinking water is
- | | |
|----------------|----------------|
| (a) 0.05 mg/l | (b) 0.005 mg/l |
| (c) 0.001 mg/l | (d) 0.5 mg/l. |