(b) A 30 cm dia sewer having an invert slope of 1 in 150 was flowing full. What would be the velocity of flow and discharge? (n=0.013). Is the velocity self-cleansing?
What would be the velocity and the discharge when the same is flowing at 0.20 and 0.8 of the full depth. Assume required data.

5 + 7 = 12

Group – E

8. (a) The sewage is flowing at the rate of 4.5 million liters per day from a primary clarifier to a standard rate trickling filter. The 5 day BOD of the influent is 160 mg/L. The value of the adopted organic loading is to be 160 gm/m^3/day and the surface loading as 2000 L/m^2/day. Find the volume of filter, depth of filter media required and efficiency of filter.

(b) Write the disadvantages of a trickling filter and mention the remedies to overcome it.

7 + 5 = 12

9. (a) An average operating data for conventional activated sludge treatment plant is as follows:
Wastewater flow = 3500m^3/day
Volume of aeration tank = 10900 m^3
Influent BOD = 250 mg/L
Effluent BOD = 20 mg/L
MLSS = 2500 mg/L
Effluent suspended solids = 9700 mg/L
Quantity of waste sludge = 220 m^3/day
Find aeration period in hours, F/M ratio, efficiency of BOD removal and sludge age and also draw the schematic diagram with values.

(b) Average sewage flow from a city is 80 × 106 L/day. If average 5 day BOD is 280 mg/L, compute total 5 day daily oxygen demand in kg and population equivalent of storage.

9 + 3 = 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) The organism which exhibits very nearly the characteristics of an ideal pathogenic indicator is:
(a) Entamoeba histolytica (b) Escherichia coli
(c) Salmonella typhi (d) Vibrio comma.

(ii) A water sample has pH of 9.25. The concentration of hydroxyl ions in the water sample is
(a) $10^{-9.25}$ mol/L (b) $10^{-4.75}$ mmol/L
(c) 0.302 mg/L (d) 3.020 mg/L.

(iii) Free available chlorine is
(a) OCl^- (b) HOCL
(c) OCl^- + HOCL (d) $Ca(OCl)_2$.

(iv) Which of the following causes a decrease in per capita consumption?
(a) Use of metering system (b) Good quality of water
(c) Better standard of living of the people (d) Hotter climate.

(v) A water treatment plant is designed to treat 1m^3/s of raw water. It has 14 sand filters. Surface area of each filter is 50 m^2. What is the loading rate (in m^3/m^2 day) with two filters out of service for routine backwashing?
(a) 144 (b)164 (c)182 (d)134.

(vi) The most suitable section of a sewer in a combined sewerage system is

(a) rectangular (b) circular
(c) parabolic (d) new egg shape.

(vii) The flow velocity in a sewer does not depend on

(a) its grade (b) its hydraulic mean depth
(c) its length (d) its roughness.

(viii) Crown corrosion in a reinforced concrete sewer is caused by

(a) H_2S (b) CO^2 (c) CH^4 (d) NH^3.

(ix) Which of the following sewage treatment methods has inherent problems of odour, ponding, and fly nuisance?

(a) UASB system (b) Activated sludge process
(c) Trickling filters (d) Stabilization ponds.

(x) A sample is digested with silver sulphate, sulphuric acid, potassium dichromate and mercuric sulphate in chemical oxygen demand (COD) test. The digested sample is then titrated with standard ferrous ammonium sulphate (FAS) to determine the un-reacted amount of

(a) Mercuric sulphate (b) Potassium dichromate
(c) Silver sulphate (d) Sulphuric acid.

Group – B

2. List the test to be performed to determine impurities in water. In this context explain the term "Hardness" and "Alkalinity" of water in terms of causes, classifications as appropriate, and effects due to consumption and the test relevant therein.

12

3. (a) Write short notes on :
(i) Total solids
(ii) Colour and odour of water

(b) State the permissible and acceptable value for chromium and colour according to the IS code.

10 + 2 = 12

Group – C

4.(a) Given the following data, calculate the population at the end of next three decades by decreasing rate method and incremental increase method.

year	Population
1940	85000
1950	130000
1960	168000
1970	228580

(b) Describe briefly coincident draft.

8 + 4 = 12

5. (a) Differentiate between rapid gravity filter and slow sand filter.

(b) A rectangular sedimentation basin is to handle 10 million litres/day of raw water. A detention basin of width to length ratio of 1/3 is proposed to trap all particles larger than 0·04 mm in size. Assume a relative density of 2·65 for the particles and 20°C as the average temperature. Compute the basin dimensions. If the depth of tank is 3·5 m, calculate the detention time.

4 + 8 = 12

Group – D

6. (a) What do you mean by variation in flow of sewage? Explain average flow, dry weather flow, and maximum flow.

(b) Write a short note on following terms:
(i) Self cleansing velocity
(ii) Non-scouring velocity

5 + 7 = 12

7. (a) State the three important design criteria for a sanitary sewer (under Indian conditions) in a town with 30,000 population.