

**ENVIRONMENTAL ENGINEERING
(CIV2205)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) The average quantity of water (in lpcd) required for domestic purposes according to IS code is
 - (a) 100
 - (b) 120
 - (c) 70
 - (d) 135
- (ii) What is the fire demand of the city of 1lakh population by Buston's formula?
 - (a) 5663
 - (b) 56630
 - (c) 566300
 - (d) 5663000
- (iii) If in a city, the maximum daily draft is 25MLD, fire draft is 35MLD and maximum hourly draft is 40MLD, what is the coincident draft?
 - (a) 60MLD
 - (b) 40 MLD
 - (c) 35 MLD
 - (d) 25 MLD
- (iv) What is the term for the process of removing salt and other impurities from seawater or brackish water to make it safe for drinking?
 - (a) Filtration
 - (b) Coagulation
 - (c) Desalination
 - (d) Aeration
- (v) Which of the following water treatment processes is most effective at removing hardness-causing ions like calcium and magnesium?
 - (a) Sedimentation
 - (b) Flocculation
 - (c) Softening
 - (d) Desalination
- (vi) Which of the following substances can contribute to alkalinity in natural water bodies?
 - (a) Vinegar (acetic acid)
 - (b) Lemon juice (citric acid)
 - (c) Baking soda (sodium bicarbonate)
 - (d) Hydrochloric acid (HCl)

- (vii) A combined sewer is one which transport:
 (a) Domestic sewage and storm water
 (b) Domestic sewage and industrial waste
 (c) Domestic sewage
 (d) Domestic sewage, industrial waste and storm water
- (viii) In a circular sewer of dia D, if the depth of the flow is $\frac{1}{4} D$, the wetted perimeter will be equal to:
 (a) $\frac{\pi D}{2}$
 (b) $\frac{\pi D}{3}$
 (c) $\frac{\pi D}{4}$
 (d) none of these
- (ix) Which of the following is an example of 'Attached growth biological secondary treatment process' for treatment of sewage?
 (a) Trickling filter
 (b) Activated sludge process
 (c) Oxidation ditch
 (d) Imhoff tanks
- (x) Biochemical Oxygen Demand (BOD) of sewage is the:
 (a) Oxygen required to oxidise biologically active organic matter
 (b) Oxygen required to oxidise biologically inactive organic matter
 (c) (a) and (b) both
 (d) none of these

Fill in the blanks with the correct word

- (xi) $BOD_5 = (DO_{\text{initial}} - DO_{\text{final}}) \times \underline{\hspace{2cm}}$
- (xii) The permissible limit of Arsenic in drinking water $\underline{\hspace{2cm}}$.
- (xiii) BOD_5 represents 5-days biochemical oxygen demand at a temperature of $\underline{\hspace{2cm}}$.
- (xiv) The method involves exchanging calcium and magnesium ions with sodium ions to soften water is $\underline{\hspace{2cm}}$.
- (xv) Unit for turbidity is $\underline{\hspace{2cm}}$ unit.

Group - B

2. (a) The average increase in the population of a town per decades over a period of 6 decades was 4100 and the average percentage increase was 12% . If the population at the end of the sixth decades was 2,20,000, estimate the population two decades later by the arithmetic increase and the geometric increase methods. [[CO2](Analyse/HOCQ)]
- (b) What are the different methods for population forecasting? [[CO2](Understand/IOCQ)]
10 + 2 = 12
3. (a) Discuss in details about the factors affecting the per capita demand . [[CO2](Remember/LOCQ)]
- (b) Draw and describe the population growth curve. [[CO2](Understand/IOCQ)]
8 + 4 = 12

Group - C

4. (a) A water sample contains the following dissolve ions . $\text{Na}^+ = 56 \text{ mg/l}$ $\text{Ca}^{+2} = 40 \text{ mg/l}$, $\text{Mg}^{+2} = 30 \text{ mg/l}$, $\text{Al}^{+3} = 3 \text{ mg/l}$, $\text{HCO}_3^- = 190 \text{ mg/l}$, $\text{Cl}^- = 165 \text{ mg/l}$. Calculate (i) Total Hardness (ii) Non - Carbonate Hardness. [[C01](Analyse/HOCQ)]
- (b) Draw the flowchart showing the different process of water treatment. [[C03](Understand/IOCQ)]
7 + 5 = 12
5. (a) What are the different types of chlorination explain each type , mention the amount of chlorine required for various types. [[C03](Understand/IOCQ)]
- (b) What is water softening mention different methods of removing permanent hardness. [[C03](Understand/IOCQ)]
8 + 4 = 12

Group - D

6. (a) Explain three general types of sewer collection systems. [[C05](Analyse/HOCQ)]
- (b) Explain the terms (i) sewage (ii) sullage (iii) sewer. [[C05](Understand/IOCQ)]
6 + 6 = 12
7. (a) A 350 mm dia sewer is to flow at 0.35 depth on a grade ensuring a degree of self-cleansing equivalent to that obtained at full depth at a velocity of 0.8m/sec. Find the (i) required grade (ii) associated velocity (iii) the rate of discharge at this depth. Given: Mannings Rugosity coefficient- 0.014, proportionate area- 0.315, proportionate wetted perimeter- 0.472, proportionate HMD (r/R)- 0.7705 [[C05](Analyse/HOCQ)]
- (b) Write short note on 'catch basins/catchpits'. [[C05](Understand/IOCQ)]
9 + 3 = 12

Group - E

8. Explain the following terms in respect to activated sludge plant in details:
- (i) Hydraulic retention time
 - (ii) Volumetric loading
 - (iii) Food to micro-organism ratio
 - (iv) Sludge age. [[C04](Understand/IOCQ)]
(4 × 3) = 12
9. (a) An average operating data for conventional activated sludge treatment plant is as follows:
Wastewater flow = $3500 \text{ m}^3/\text{day}$
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 m³/day

Find aeration period in hours, F/M ratio, efficiency of BOD removal and sludge age.

[[C04](Analyse/HOCQ)]

(b) Draw the schematic diagram with values.

[[C04](Understand/IOCQ)]

9 + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	8.3	49	42.7