ENVIRONMENTAL ENGINEERING
(CIVL 3103)

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) Which is the correct statement regarding per capita demand?
(a) Daily water required by an individual
(b) Water required for various purposes by a person
(c) Water required by an individual in a year
(d) Annual average amount of daily water required by one person.

(ii) 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.

(iii) What is the recommended minimum contact time for chlorine disinfection in water treatment?
(a) 5 minutes (b) 30 minutes
(c) 2 hours (d) 24 hours.

(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) 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.

(vii) Pick up the correct statement from the following
With self-cleansing velocity in sewers,
(a) the silting occurs at the bottom
(b) the scouring occurs at the bottom
(c) the silting and scouring both occur at the bottom
(d) neither the silting or scouring occur at the bottom.

(viii) Blue baby disease *(methemoglobinemia)* in children is caused by the presence of excess
(a) Chloride (b) Nitrate
(c) Fluoride (d) Lead

(ix) MPN index is a measure of which of the following?
(a) Coliform bacteria (b) BOD_5
(c) Dissolved oxygen content (d) Hardness.

(x) 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.

Fill in the blanks with the correct word

(xi) The permissible limit of Arsenic in drinking water _____.

(xii) COD stands for _____.

(xiii) BOD_5 represents 5-days biochemical oxygen demand at a temperature of _____.

(xiv) The method involves exchanging calcium and magnesium ions with sodium ions to soften water is _____.

(xv) Unit for turbidity is _____ unit.

Group - B

2. (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

3. (a) The population of a locality as obtained from census report as follows :

Year	1911	1921	1931	1941	1951
Population	3,50,000	4,66,000	9,94,000	15,60,000	16,23,000

Estimate the population of the locality in the year 2001 by using incremental increase method. *[(CO2)(Analyse/HOCQ)]*

(b) What is peak-hour demand? Sketch the fluctuations in demand for typical Indian conditions. *[(CO2)(Understand/IOCQ)]*

7 + 5 = 12

Group - C

4. (a) A water sample contains the following dissolve ions. Na^{+} = 56 mg/l Ca +2 = 40 mg/l, Mg^{+2} = 30 mg/l, Al^{+3} = 3 mg/l, HCO^{-}_{3} =190 mg/l, Cl^{-} = 165 mg/l. Calculate (i) Total Hardness (ii) Non-Carbonate Hardness. *[(CO1)(Analyse/HOCQ)]*

   (b) Draw the flowchart showing the different process of water treatment. *[(CO3)(Understand/IOCQ)]*

7 + 5 = 12

5. (a) In a continuous flow settling tank 3m deep and 60 m long , what flow velocity of water would you recommend for effective removal of 0.025 mm particles at 25°C. The specific gravity of particles is 2.65, and kinematic viscosity for water may be taken as 0.01 cm^2 /sec. *[(CO3)(Analyse/HOCQ)]*

   (b) Write short note on Backwashing. *[(CO3)(Remember/LOCQ)]*

8 + 4 = 12

Group - D

6. (a) Explain three general types of sewer collection systems. *[(CO5)(Analyse/HOCQ)]*

   (b) Explain the terms (i) sewage (ii) sullage (iii) sewer. *[(CO5)(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 *[(CO5)(Analyse/HOCQ)]*

   (b) Write short note on 'catch basins/ catchpits'. *[(CO5)(Understand/IOCQ)]*

9 + 3 = 12

Group - E

8. (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. *[(CO4)(Analyse/HOCQ)]*

   (b) Draw the schematic diagram with values. *[(CO4)(Understand/IOCQ)]*

9 + 3 = 12

9. 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.

[(CO4)(Understand/IOCQ)]

(4 × 3) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.5	39.6	47.9