

**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 consumption of water required in factories in lpcd is _____
 - (a) 10-15
 - (b) 20-30
 - (c) 30-45
 - (d) 70-80
- (ii) 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
- (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 primary purpose of coagulation in water treatment?
 - (a) To kill bacteria and viruses
 - (b) To remove dissolved minerals
 - (c) To remove color and odor
 - (d) To clump together small particles for easier removal
- (v) The purpose of re-carbonation after lime-soda process of water softening is the
 - (a) Removal of excess soda from water
 - (b) Removal of Non-Carbonate hardness
 - (c) Recovery of lime
 - (d) Conversion of precipitate to soluble form.
- (vi) The effect of increasing the diameter of a sewer, on the self-cleansing velocity, is:
 - (a) to increase it
 - (b) to decrease it
 - (c) not to cause any effect
 - (d) all of the above

- (vii) An egg-shaped sewer, when compared to a circular sewer is:
 (a) economical
 (b) more stable
 (c) easier to construct
 (d) provides better self-cleansing property velocity at low discharges
- (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) Blue baby disease (*methemoglobinemia*) in children is caused by the presence of excess
 (a) Chloride
 (b) Nitrate
 (c) Fluoride
 (d) Lead
- (x) BOD/COD ratio will always be:
 (a) equal to 1
 (b) less than 1
 (c) more than 1
 (d) none of these

Fill in the blanks with the correct word

- (xi) The Indicator used to measure Total hardness is _____.
- (xii) The minimum domestic water consumption for weaker section in India is _____.
- (xiii) The most toxic form of Nitrate is _____.
- (xiv) COD stands for _____.
- (xv) As per IS 10500:2012, pH for drinking water is _____.

Group - B

2. (a) Discuss the following :
 Intermittent supply versus continuous supply .
 Single supply versus dual supply .
 Metered supply versus non-metered supply . [[CO2](Understand/IOCQ)]
- (b) Write short notes on "fire demand " & " Coincident Draft". [[CO2](Remember/LOCQ)]
- 6 + 6 = 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. Write short notes on any of the following 3 topics:-
Chlorination
Rapid Sand filter
Coagulation & flocculation
softening

[[C03](Remember/LOCQ)]

(3 × 4) = 12

5. (a) A water sample containing 100 mg/l of $[\text{CO}_3^{2-}]$ & 75 mg/l of $[\text{HCO}_3^-]$. The pH of the water is 10. Calculate the approximate alkalinity & exact alkalinity in terms of CaCO_3 .
(b) Draw the breakpoint chlorination graph and mention the different forms of chlorination.

[[C01](Analyse/HOCQ)]

[[C03](Remember/LOCQ)]

8 + 4 = 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:
Self-cleansing velocity
Non-scouring velocity.

[[C05](Remember/LOCQ)]

[[C05](Remember/LOCQ)]

6 + 6 = 12

7. (a) A combined sewer of a circular section is to be laid to serve a particular area. Calculate the size of the sewer from the following data:
Area to be served = 120 hectares
Population = 1,00,000
Maximum permissible flow velocity = 3 m/sec
Time of entry for storm water = 10 min
Time of flow in channel = 20 min
Per capita water supply = 250 lit/day/person
Coefficient of run-off for the area = 0.45
Hourly maximum rainfall for the area at the design frequency = 5 cm
Assume any other data, if needed.
(b) Determine the size of a circular sewer for a discharge of 600 litres/sec running half full. Assume $i = 0.001$ and $n = 0.015$.

[[C05](Analyse/HOCQ)]

[[C05](Analyse/HOCQ)]

8 + 4 = 12

Group - E

8. (a) Draw the flow diagram for the 'activated sludge process', and describe the working of the activated sludge plant.
(b) Explain 'Population Equivalent'.

[[C04](Understand/IOCQ)]

[[C01](Remember/LOCQ)]

- (c) Calculate the population equivalent of a city given (i) the average sewage from the city is 95×10^6 L/day and (ii) average 5-day BOD is 250mg/L.

[[CO4](Apply/IOCQ)]

6 + 3 + 3 = 12

9. (a) Explain the quality parameters of wastewater under physical, chemical, and biological categories.

[[CO1](Understand/LOCQ)]

- (b) Describe the typical flow chart of a municipal wastewater treatment plant, and discuss the working principles of any two secondary treatment processes.

[[CO4](Apply/IOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	44.8	27	28.2