WATER AND LIQUID WASTE MANAGEMENT
(CHE3121)

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 minimum DO level (in mg/L) in drinking water is
(a) 8 (b) 7
(c) 6 (d) 5

(ii) Identify the Environment Act/Rules which is related with genesis of an Apex body on Environment Pollution in India.
(a) Water Act (b) Air Act
(c) Bengal Smoke Nuisance Act (d) E-waste (Management) Rules

(iii) The flow of water in open drain is conveniently measured by
(a) Rotameter (b) Pitot tube
(c) Weir (d) Venturimeter

(iv) The depth of facultative waste stabilization pond is
(a) less than 0.3 m (b) 1 – 2 m
(c) 3 – 4 m (d) none of these

(v) In Composite Sampling of wastewater the following parameter is significant
(a) Pressure (b) Temperature
(c) Flow (d) BOD

(vi) Fujimoto method can be used for calculations related to
(a) TS (b) TDS
(c) BOD (d) COD

(vii) When alum is added to the wastewater containing ions which compound is formed as a precipitate?
(a) $Al_2(SO_4)_3$ (b) $CaCO_3$
(c) $Al(OH)_3$ (d) $Ca(OH)_2$

(viii) Assume in a sample of wastewater around 60% TSS is removed by primary sedimentation without chemical addition. Calculate the mass of TSS removed for the following data, Amount of TSS present initially is 220 mg/L and wastewater flow is 1000 m^3/d.

(a) 132 Kg/d (b) 100 Kg/d
(c) 102 Kg/d (d) 130Kg/d

(ix) Tannery sludge is mostly

(a) Landfilled (b) Used as biochar
(c) Mixed with fertilizer (d) Recycled

(x) The effluent of digester in a pulp mill employing Kraft process is known as

(a) Black Liquor (b) Red Liquor
(c) Green Liquor (d) White Liquor

Fill in the blanks with the correct word

(xi) As per CPCB standard, class E water is suitable for _____ .

(xii) A systematic process of objectively obtaining a water balance by measuring flow of water from the site of water withdrawal or treatment is known as Water _____.

(xiii) The kinetics of microbiological growth rates is modelled using _____ equation.

(xiv) The color of a wastewater sample is measured in _____ units.

(xv) The Primary Wastewater treatment is sufficient for effluent with BOD <= _____

Group - B

2. (a) Mention the selection criteria for flow metering devices used for wastewater. *[(CO1)(Remember/LOCQ)]*

(b) Discuss about metering devices used for wastewater flow measurement. *[(CO1)(Apply/IOCQ)]*

4 + 8 = 12

3. (a) Enumerate the types of Industries as per the directives of Central/State Boards. *[(CO1) (Remember/LOCQ)]*

(b) State and explain the process of obtaining NOC from WBPCB (Consent to Establish) for setting up a Heavy Industry. *[(CO1) (Analyze/IOCQ)]*

4 + (4 + 4) = 12

Group - C

4. (a) Differentiate between *sludge age* and *hydraulic retention time* in case of an activated sludge process. *[(CO4)(Apply/IOCQ)]*

(b) Calculate the diameter of a trickling filter (with necessary recirculation) for the following data:
Sewage flow – 4800 m^3/day, raw settled BOD - 180 mg/L, filter depth - 1.8 m., desired efficiency = 0.85, recirculation – as necessary. *[(CO4)(Evaluate/HOCQ)]*

(c) What do you understand by COD of waste water? How can it be measured?

[(CO2)(Apply/IOCQ)]

3 + 6 + 3 = 12

5. A wastewater contains the following:
150 mg/l ethylene glycol; 100 mg/l phenol; 40 mg/l sulfide (S^{2-}); 125 mg/l ethylene diamine hydrate (essentially non biodegradable)
(i) Compute COD and TOC.
(ii) Compute BOD_5 if the k_{10} is 0.2/day. *[(CO2)(Evaluate/HOCQ)]*

[(3 + 3) + 6] = 12

Group - D

6. (a) Determine the amount (in Kg/day and m^3/day) of primary sludge solids generated in a domestic treatment plant for a P.E of 20,000 with an efficiency of (TSS) removal of 60%.
(b) What is the density of primary sewage sludge if it is 2% dry solids (i.e 98% water)? *[(CO4)(Analyse/HOCQ)]*

6 + 6 = 12

7. (a) What is Jar Test? State its operation with a schematic diagram.

[(CO4)(Remember/LOCQ)]

(b) You are to determine the optimal coagulant dosage and mixing conditions for a water treatment plant obtaining potable water -- delineate the process.

[(CO4)(Analyze/IOCQ)]

(2 + 4) + 6 = 12

Group - E

8. (a) In an industrial biogas plant food waste is anaerobically digested to produce biogas. The slurry contains 10% of solids food grains. The elemental composition of the waste food grains on dry basis is C: 52%, H: 9%, O: 29%, N: 10% (mass %). Around 85% of the waste food grains are converted to biogas and all the converted hydrogen forms methane. If the flow rat of the slurry is 4000 litre per day. Calculate the rate of biogas (CO_2+ CH_4) production. *[(CO4)(Analyse/HOCQ)]*
(b) Draw the block diagram of treatment methods of paper industry effluents.

[(CO2)(Remember/LOCQ)]

8 + 4 = 12

9. (a) You are to develop an engineering package of wastewater treatment for an Amusement Park which houses 10 restaurants. On an average, about 10,000 visitors come to the park daily.
Show your sequence of activities following the methodology of Ranking of wastewater treatment alternative. *[(CO4)(Analyse/IOCQ)]*

(b) For developing such package, some Process variables scores are added, while some of those are subtracted. – Explain with reasons. *[(CO4)(Evaluate/HOCQ)]*

8 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	18.75	37.5	43.75