WATER AND LIQUID WASTE MANAGEMENT
(CHEN 3221)

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) Sullage is another name of
(a) black water (b) grit
(c) grey water (d) storm water

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

(iii) 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

(iv) With rise in temperature, oxygen content in water
(a) rises (b) drops
(c) remains same (d) may rise or drop

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

(vi) 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) $Ca(OH)_2$

(vii) Which of the following is the most commonly used coagulant?
(a) Ferric sulphate (b) Coal
(c) Alum (d) Limestone.

(viii) The Bacterilogical quality of drinking water is measured by
(a) MPN method (b) Chloroscope
(c) Colorimeter (d) Winkler's method

(ix) Boiler ash contains potash, mixed with press mud and filtrate sludge to produce
(a) Ethanol (b) Brick (c) Bio manure (d) Detergent

(x) As per Ranking of Wastewater Treatment Methodologies, the most efficient system is
(a) Extended Aeration System (b) Activate Sludge Process
(c) Anaerobic Fixed Film Reactor (d) Rotating Biological Disc Contactor.

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) (F/M) ratio is known as _____ ratio.

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

(xv) Tannery wastewater largely contains metal-salt viz. _____.

Group - B

2. (a) What do you understand by water quality? *[(CO1)(Understand/LOCQ)]*
(b) Mention the objectives of water audit. *[(CO1)(Remember/LOCQ)]*
(c) Write down the classification of water and wastewater as per Water Quality Standard prevalent in India. Also mention the parameters involved. *[(CO1)(Apply/IOCQ)]*

2 + 4 + 6 = 12

3. (a) Rainwater Harvesting is a step towards sustainability, but it may arise technological problems as well — explain with reasons. *[(CO3)(Analyse/IOCQ)]*
(b) Explain critically the statement: "The water audit spreadsheet is a useful tool to evaluate water use in the home." *[(CO3)(Analyze/IOCQ)]*

6 + 6 = 12

Group - C

4. (a) Mention various characteristics of wastewater. *[(CO3)(Remember/LOCQ)]*
(b) The following test results were obtained for a wastewater sample of 50 mL. Determine the concentration of total solids, total volatile solids, suspended solids and volatile suspended solids.
Tare mass of evaporating disc = 54.5433 g
Mass of evaporating disc plus residue after evaporation at 105^0C = 54.582 g
Mass of evaporating disc plus residue after ignition at 550^0C = 54.573 g
Tare mass of Whatman filter = 1.5433 g
Residue on Whatman filter after drying at 105^0C = 1.5552 g
Residue on Whatman filter after ignition at 550^0C = 1.5534 g. *[(CO2)(Evaluate/HOCQ)]*
(c) What do you understand by COD of waste water? How can it be measured? *[(CO2)(Apply/IOCQ)]*

2 + 7 + 3 = 12

5. (a) Find L_0 from industrial BOD Data using Fujimoto method. (A mm graph paper will be needed).

t (day)	0	1	2	3	4	5	6	7
BOD mg/l	0	57	102	134	160	184	199	207

[(CO2)(Evaluate/HOCQ)]

(b) Deduce the standard relationships in Streeter – Phelps Oxygen Sag Curve and find out x_c and t_c. *[(CO2)(Analyze/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) Briefly discuss the municipal wastewater treatment process with a help of a flow chart. *[(CO4)(Remember/LOCQ)]*

(b) Attempt any two of the followings:

(i) Discuss the advantages and disadvantages of using chlorine as a disinfectant.

(ii) Explain in detail the process of UV disinfection.

(iii) Explain the process of reverse osmosis using figures to aid your explanation.

[(CO2)(Analyse/IOCQ)]

6 + (3 × 2) = 12

7. (a) Draw the layout of a Water Treatment Plant. *[(CO4)(Remember/LOCQ)]*

(b) Discuss various water disinfection techniques practiced in water treatment plants operating in Kolkata Metropolitan Area. *[(CO4)(Remember/LOCQ)]*

5 + 7 = 12

Group - E

8. (a) Explain the oxygen pond treatment for liquid effluent from an Indian refinery with the help of neat block diagram. *[(CO2)(Understand/LOCQ)]*

(b) The flow rate of chrome bearing wastewater from a tannery unit is 2KL/day contains chromium concentrations (Cr^{+3}) of 20 mg/L. the efficiency of chromium recovery unit is 95%. Then, Calculate the amount of fresh chromium sulphate required per day. *[(CO4)(Apply/IOCQ)]*

8 + 4 = 12

9. Prepare preliminary designs for a Rotating Bio-disc type installation for a distillery with influent BOD 270 mg/l with total BOD load 54 kg/day.
Assume 80 % BOD removal at an organic load of 20 g BOD/m^2 . day and 3m diameter discs spaced 5 cm apart on centres.

(i) Determine tank volume

(ii) Hydraulic load on Disk and Surface load on tank and other parameters.

[(CO4)(Evaluate/HOCQ)]

(5 + 7) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.42	38.34	26.04