WATER AND LIQUID WASTE MANAGEMENT
(CHEN 3221)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The centralized global program on Plastic Pollution in Oceans in connection with World Environment Day 2023 will be hosted by:
(a) Spain (b) Sweden (c) Côte d'Ivoire (d) Pakistan.

(ii) As per the CPCB standard for Type A water signifies
(a) Untreated Sewage
(b) Water having requisite Bathing Standard
(c) Drinking Water
(d) Treated wastewater for irrigation purpose.

(iii) _____ is an example of attached growth system.
(a) Trickling filter (b) Aerated lagoon
(c) Waste stabilization pond (d) Activated sludge process

(iv) Which type of washing is adopted in industries to conserve the water?
(a) Cross current flow (b) Parallel flow
(c) Parallel and cross flow (d) Counter current flow.

(v) Grey water is also termed as
(a) Sullage (b) Grit (c) Moss (d) Sewage.

(vi) The depth of anaerobic waste stabilization pond is
(a) 0.3 - 0.5 m (b) 1 - 2 m (c) 3 - 4 m (d) None of the above.

(vii) As per the CPCB standard for discharge of liquid waste into inland surface water the values of COD in mg/l for treated waste water is
(a) less than or equal to 150 (b) 0
(b) 30 (d) >150.

(viii) The Root-zone/Reed Bed Treatment uses
(a) Neem (b) Zoo Plankton
(c) Babul (d) Typha elephantiana.

(ix) Imhoff cone is used during to measure the _____ content of wastewater.
(a) colloidal solid (b) suspended solid
(c) dissolved solid (d) settlable solids

(x) Uniformity co-efficient of sand is an important parameter in
(a) extended aeration system (b) slow bed filtration process
(c) trickling filter (d) all of the above.

Group- B

2. (a) Briefly discuss the surface water treatment methods with a help of a block diagram. [(CO2)(Remember/LOCQ)]

(b) Find the rate of discharge for the followings:
(i) The head over a triangular notch is 0.2 m and angle is 60^0. Assume the coefficient of discharge is 0.6.
(ii) A horizontal venturi meter with an inlet and throat diameter of 500 mm and 250 mm is connected to a manometer. The differential reading is 100 mm of mercury. Assume the coefficient of discharge is 0.98.

[(CO2)(Evaluate/HOCQ)]

6 + (2 + 4) = 12

3. (a) (i) Write the action plans adept by the industries to reduce the consumption of water and to conserve the water.
(ii) Discuss the various artificial recharge technology for harvesting the water.

[(CO1,CO3)(Remember/LOCQ)]

(b) A waste water flow of 15,000 m^3/day is received at a sewage treatment plant from few industries and a city with population of 20,000. The BOD_5 of wastewater is 200 mg/l. Calculate the BOD for domestic sewage.

[(CO2)(Evaluate/HOCQ)]

(c) Why the water audit is steered in the industry? [(CO1)(Analyse/IOCQ)]

(3 + 4) + 3 + 2 = 12

Group - C

4. (a) In an activated sludge aeration system (aeration tank volume is 700 m^3) , the influent BOD is reduced from 270 mg/l to 30mg/l. The flowrate is 3600 m^3/day and MLVSS = 3000 mg/l. Assuming, yield coefficient = 0.5 and decay rate constant = 0.9/day, compute weight of net sludge produced per day, sludge age, hydraulic retention time and food/microorganism ratio.

[(CO4)(Evaluate/HOCQ)]

(b) Discuss the types of waste stabilization ponds and their working principle.

[(CO4)(Remember/LOCQ)]

7 + 5 = 12

5. Prepare preliminary designs for a rotating Bio-disc type installation to serve 1000 persons. Assume 80 per cent BOD removal at an organic load of 20 gm BOD/m^2 day and

3 m diameter discs, spaced 5 cm apart on centres. Assume 54 g BOD person/day and 200 litres flow per person /day. [(CO4)(Evaluate/HOCQ)]
12

Group – D

6. A coagulation sedimentation plant clarifies 50 million litre of water everyday. The quantity of filter alum required at the plant is 20 mg/L. The raw water is having an alkalinity equivalent to 5 mg/l of $CaCO_3$. Determine the quantity of filter alum and the quick lime (containing 50% of CaO) required per year by the plant.
[(CO1,CO2,CO4)(Evaluate/HOCQ)]
12

7. Write short notes on any three of the followings:
   (i) Wet intake tower
   (ii) Fluoridation
   (iii) Membrane technology
   (iv) Removal of Colour, odour and taste from water.
[(CO3)(Remember/LOCQ)]
(3 × 4) = 12

Group – E

8. The analysis Wastewater from a Coke-oven Battery is as follows:
200 mg/l ethylene glycol ($C_2H_6O_2$); 130 mg/l phenol (C_6H_6O); 50 mg/l sulphide (S^{2-}); 150 mg/l ethylene diamine hydrate ($C_2H_{10}N_2O$) which is essentially nonbiodegradable.
   (i) Compute the COD and TOC.
   (ii) Compute the BOD_5 if the k_{10} is 0.2/day.
   (iii) After treatment, the BOD_5 is 27 mg/l, Estimate the COD (k_{10} = 0.1/day).
(CO3)(Evaluate/HOCQ)]
(4 + 4 + 4) = 12

9. (a) In an industrial biogas plant food waste is anaerobically digested to produce biogas. The slurry contains 10% of solid 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 atoms methane. If the flow rate of the slurry is 4000 litre per day, calculate the rate of the biogas (CO_2 + CH_4) production.
[(CO3,CO4)(Evaluate/HOCQ)]

   (b) Draw the block diagram of petroleum refinery emitted wate water treatment plant. [(CO4)(Understand/IOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	31.25	8.33	60.42

Course Outcomes (CO):

At the end of the course the students should be able:

1. The students will be able to identify the importance of Legislative orders prevalent in India concerning Water and Liquid Waste Management.
2. The students will be able to describe the methodology of Establishing and Operating Water and Liquid Waste intensive processes.
3. The students will be able to use the principles of Water Management in order to conserve water and solve water-shortage problems prevalent in India.
4. The students will be able to design the Water Treatment and Wastewater Treatment plants following the standard code of practice.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question