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
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> 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 theme of World Environment Day 2024 was related to
(a) Land Restoration & Draught Resilience   (b) Air Pollution
(c) Food Security   (d) Beat Plastic Pollution.

(ii) The IS acceptable range of turbidity in drinking water is
(a) 0.1 to 0.5 NTU   (b) 100 to 250 NTU
(c) 10 to 25 NTU   (d) 1 to 10 NTU.

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

(iv) With rise in temperature, oxygen content in water
(a) increases   (b) decreases
(c) remain same   (d) may increases or decreases.

(v) The extended aeration system does <u>not</u> require
(a) a Primary Clarifier   (b) power
(c) Aerator   (d) skilled operator

(vi) Aeration tank is used in effluent treatment plant of a sugar industry to reduce the
(a) Carbon content   (b) Glucose content
(c) TOC content   (d) BOD and COD

(vii) Identify the suitable flowmeter used in a wastewater treatment plant
(a) pitot tube   (b) orifice meter
(c) weir   (d) All of these

(viii) Trickling Filter is not a suitable option for treatment of wastewater in
(a) African countries   (b) India
(c) Scandinavian countries   (d) All over the world

(ix)   The sour water stripper is used in refinery liquid waste treatment plant to
(a) Remove H_2S and NH_3 (b) Remove H_2SO_4 and NH_4OH
(c) Remove CO_2 (d) Remove SO_2

(x)   Uniformity co-efficient of sand is an important parameter in
(a) Extended Aeration system   (b) Slow bed filtration process
(c) Trickling Filter   (d) Rain water harvesting.

Fill in the blanks with the correct word

(xi)   As per the CPCB standard the values of COD in mg/l for treated wastewater which can be discharged in inland surface water is Less than or equal to __.

(xii)   The recharge well method is most suitable for multi-storied building having roof area _____ m^2.

(xiii)   _____ is an example of suspended growth system.

(xiv)   The Aerobic waste stabilization pond should maximize _____ penetration.

(xv)   In order to meet discharge standards, AFFR may require further ____ treatment.

Group - B

2.   (a)   The Water Act 1974 is basically to formulate an Apex Statutory Body regarding Environment/Water Pollution -- Analyze.   *[(CO1)(Analyse/IOCQ)]*
   (b)   List out four basic objectives of Water Audit.   *[(CO2)(Understand/LOCQ)]*
   (c)   Which documents are required to submit to the state pollution control board for obtaining consent to establish (CTE)?   *[(CO1)(Understand/IOCQ)]*
   (d)   What are the criteria of "A" quality water?   *[(CO1)(Remember/LOCQ)]*
             4 + 4 + 2 + 2 = 12

3.   (a)   Briefly discuss the water conservation methodologies applied in process industry to minimize the water consumption.   *[(CO3)(Analyse/IOCQ)]*
   (b)   Describe the technical design of a ground water recharge method most suitable for an area not below 2 meter deep from the ground level.   *[(CO4)(Understand/HOCQ)]*
   (c)   Name two important Rainwater Harvesting techniques suitable for cities.
             [(CO3)(Remember/LOCQ)]
             4 + 6 + 2 = 12

Group - C

4.   (a)   Trickling Filter is not actually a filter — explain.   *[(CO4)(Analyse/IOCQ)]*
   (b)   Discuss Fujimoto method of BOD analysis.   *[(CO3)(Analyse/IOCQ)]*
   (c)   Design a trickling filter using an empirical method usingthe following data. Sewage flow = 5000m3/day; Raw settled BOD = 1000 kg/day; Filter depth = 1.8 m Media 7.5-10 cm stones; Recirculation as necessary; Efficiency desired 85%
             [(CO4)(Evaluate/HOCQ)]
             3 + 3 + 6 = 12

5. (a) Differentiate between *sludge age* and *hydraulic retention time* in case of an activated sludge process. *[(CO3)(Apply/IOCQ)]*

(b) A wastewater treatment plant discharges 1.0 m³/s of effluent having an ultimate BOD of 50.0 mg/L, into a stream flowing 10.0 m³/s. Just upstream from the discharge point, the stream has an ultimate BOD of 6.0 mg/L. The de-oxygenation rate coefficient is 0.24/day. Assuming complete and instantaneous mixing:

Find ultimate BOD of the mixture of waste and river just downstream from the outfall. *[(CO3)(Evaluate/HOCQ)]*

(c) Discuss about the facultative waste stabilization pond. *[(CO3)(Understand/LOCQ)]*

3 + 6 + 3 = 12

Group - D

6. (a) Discuss the operating principle of a Rapid Sand Bed Filter with a labelled sketch. *[(CO2)(Analyze/IOCQ)]*

(b) Write a short note on any of the following unit operations with its relevance to water treatment.

(i) Membrane technology (ii) Disinfection *[(CO2,CO3)(Remember/LOCQ)]*

8 + 4 = 12

7. (a) A drinking water treatment plant uses a circular sedimentation basin to treat 3.0 MGD of river water (1.0 MGD = 0.0438 m³/s). The river often carries 0.010 mm silt particles with an average density of 2.2 g/cm³, and the silt must be removed before the water can be used. The plants clarifier is 3.5m deep and 21 m in diameter. The temperature of water is 15⁰C. The density of water at 15⁰C is 999.1 kg/m³ and viscosity is 0.00114 kg/ms.

What is the hydraulic detention time of the clarifier? *[(CO4)(Analyse/HOCQ)]*

(b) Write a note on the disinfection techniques practised in various water treatment plants in Kolkata Metropolitan Area. Provide diagram if necessary. *[(CO4)(Analyze/IOCQ)]*

6 + 6 = 12

Group - E

8. (a) Explain the recovery process of potash from alcohol industry sludge. *[(CO4)(Analyse/HOCQ)]*

(b) Delineate in brief the Monod model for degradation of tannery wastewater. *[(CO4)(Evaluate/HOCQ)]*

(c) The BOD load is exorbitant in Dairy waste — Explain with reasons. *[(CO2)(Analyze/IOCQ)]*

2 + 7 + 3 = 12

9. (a) List out a few plant species suitable for Reed Bed/Root Zone treatment. *[(CO4)(Remember/LOCQ)]*

(b) Estimate the area required for a reed bed to treat septic tank effluent with BOD 240 mg/litre to be brought down to 30 mg/litre. Assume k_{BOD} = 0.18 per day and flow = 200 litre/person/day. *[(CO4)(Evaluate/HOCQ)]*

(c)   Briefly describe the effluent treatment plant of fertilizer industry with block diagram. *[(CO4)(Evaluate/HOCQ)]*

3 + 5 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	18.75	37.5	43.75

Course Outcome (CO):

After the completion of the course students will be able to

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.