



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(FT)/SEM-5/FT-504/2011-12  
2011**

**WASTE MANAGEMENT OF FOOD INDUSTRIES**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

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

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) Type of biological waste treatment selected for industry waste depends mainly on
  - a) concentration of organic matter
  - b) volume of waste
  - c) capital and operating costs
  - d) all of these.
- ii) Inorganic ions in waste water do not cause which of the following ?
  - a) Deposition of scales on distribution pipes
  - b) Induce the growth of some microorganisms
  - c) Cause visible sludge which creates unsightly conditions of water body for recreational use
  - d) None of these.



- iii) If BOD value of influent waste water is high, one should select for its treatment
- a) Trickling filter                      b) RBC  
c) UASB                                      d) any of these.
- iv) Activated sludge process does not require
- a) Recycling of biomass  
b) Aeration  
c) Temperature control  
d) Pressure control.
- v) Thermal treatment process of solid waste under anaerobic condition
- a) is possible, if partly aerobic and partly anaerobic  
b) is possible by pyrolysis  
c) is done at 55°C  
d) does not exist.
- vi) Choose the correct alternative :
- a)  $BOD_5 \geq BOD_u \geq COD$   
b)  $COD \geq BOD_u \geq BOD_5$   
c)  $COD \geq BOD_5 \geq BOD_u$   
d)  $BOD_u \geq COD \geq BOD_5$
- vii) Trickling filter bed contains
- a) Aerobic type organisms  
b) Anaerobic type organisms  
c) Both aerobic & anaerobic organisms  
d) None of these.



- viii) Biogas can be produced by
- a) chemical industry waste
  - b) metal plating waste
  - c) fruits and vegetables processing waste
  - d) all of these.
- ix) For the composting of any organic material C/N ratio should be around
- a) 20-25
  - b) 25-30
  - c) 30-35
  - d) 35-40.
- x) Biofilter can easily treat
- a) soluble organic effluent
  - b) insoluble organic effluent
  - c) soluble organic gaseous effluent
  - d) insoluble organic gaseous effluent.
- xi) Sugar industry has high BOD waste as
- a) Filter washing waste water
  - b) Liquid discharge from caustic soda process
  - c) Molasses
  - d) Spent sugarcane.
- xii) UASB is commonly known as
- a) underflow anaerobic sludge bioreactor
  - b) upflow activated sludge bioreactor
  - c) upflow anerobic sludge blanket
  - d) underflow anaerobic sludge blanket.



- xiii) Fermentation of waste materials through anaerobic route produces
- a) gases of bad odours
  - b) gases of bad odour and vitamins
  - c) gases of bad odours and minerals
  - d) none of these.
- xiv) The BOD of a liquid waste can be characterized by
- a) MLVSS
  - b) TSS
  - c) MLSS
  - d) both (b) and (c).
- xv) Flocculation process is not important in
- a) Cannery waste
  - b) Bakery waste
  - c) Fish processing waste
  - d) Soft drink industry waste.

**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. What are the major sources of dairy waste ? What are the important characteristics of dairy waste ? Give the layout of dairy waste treatment strategy.  $1 + 2 + 2$
3. Discuss briefly some major characteristics of Tannery waste and distillery waste.  $2\frac{1}{2} + 2\frac{1}{2}$
4. Briefly discuss the advantages and disadvantages of Anaerobic treatment of liquid waste over Aerobic treatment.



5. Derive proper expression for BOD curve and write significance of this curve. 3 + 2
6. Write a short note on Trickling filter.

**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following. 3 × 15 = 45

7. The following are average operating data from a conventional activated sludge reactor :

Waster water flow : 29,000 m<sup>3</sup> /d

Volume of reactor : 8500 m<sup>3</sup>

Influent total solid : 599 mg/l

Influent suspended solid : 120 mg/l

Influent BOD : 1733 mg/l

Effluent total solid : 497 mg/l

Effluent suspended solid : 22 mg/l

Effluent BOD : 20 mg/l

MLSS : 2500 mg/l

Re-circulated sludge flow : 10,000 m<sup>3</sup> /d

Waste sludge quantity : 200 m<sup>3</sup> /d

Suspended solid in waster sludge : 9800 mg/l.

Calculate the values of : aeration period, BOD load, F/M ratio, total solid, suspended solid and BOD removal efficiencies, sludge age and return sludge rate.



8. a) A fruit and vegetable processing unit generates 1 ton of solid waste that needs to be stabilized aerobically. Estimate the amount of oxygen required to oxidize the waste. It may be assumed that the initial composition of the biodegradable organic material to be decomposed is  $[C_6H_7O_2(OH)_3]_5$  and the final composition of the residual organic matter is  $[(C_6H_7)_2(OH)_3]_2$ . After the oxidation process, 40% of the material is available as compost. Determine the amount of compost. 5
- b) Briefly discuss about anaerobic digestion process of solid waste. 7
- c) How is BOD dependent on temperature. 3
9. a) Briefly discuss on the design criteria of biofilter. Give its application. 8
- b) What is biosorption ? Why is biosorption process advantageous than chemical separation process ? Discuss applicability of this process in waste treatment process. 7
10. a) Discuss with principle the landfill bioreactor. What is called landfill gas ?
- b) Discuss briefly about sand bed drying of sludges. What is incineration ?
- c) Write short notes on production of packaged drinking water. 5 + 5 + 5

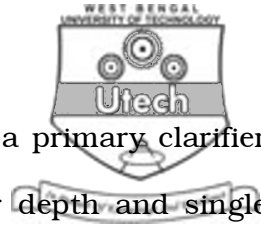


11. An RBR unit is to be designed to treat a sample of waste water based on the following assumptions :

- i) Hydraulic loading rate (  $Q$  ) =  $6000 \text{ m}^2 / \text{d}$
- ii) Influent organic concentration (  $S_i$  ) =  $300 \text{ mg BOD}_L / \text{l}$   
(Assume 90%  $\text{BOD}_L$  soluble and  $\text{BOD}_5 / \text{BOD}_L = 0.68$ )
- iii) No. of stages = 3
- iv) Organic loading rate in the first stage is either  
 $60 \text{ kg BOD}_L / 1000 \text{ m}^2 \text{ (disc area) day}$  or  
 $10 \text{ kg BOD}_L / 1000 \text{ m}^2 \text{ (disc area) day (overall)}$
- v) Tip velocity =  $20 \text{ m/min}$ .
- vi) The outflow rate in the settler of average flow =  $20 \text{ m/d}$  ( Assumed )
- vii) Specific surface area of the medium =  
 $110$  and  $170 \text{ m}^2 / \text{m}^3$  .
- viii) Shaft of standard density medium and High density medium are  $9300 \text{ m}^2$  surface area and  $14000 \text{ m}^2$  of surface area.
- ix) % Submergence = (  $25 - 40$  )

Calculate total  $\text{BOD}_L$  mass loading, soluble  $\text{BOD}_L$  loading, total area, rotational speed of the shaft and surface area of settler.

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12. A trickling filter plant has the following : a primary clarifier with a 16.8 m diameter, 2.1m side water depth and single peripheral weir, a 26.0 m diameter trickling filter depth with a 2.1 m deep stone filter bed and a final settling tank with a 15.2 m diameter, 2.1m side water depth and single peripheral weir. The normal operating recirculation ratio is 0.5 with return to the wet well from the bottom of the final during periods of low influent flow. The daily waste water flow is  $5220 \text{ m}^3 / \text{d}$  with an average BOD of 180 mg/l, essentially all domestic waste.

Calculate the loading on all of the units and the effluent BOD at  $20^\circ\text{C}$  and  $16^\circ\text{C}$ . Given that at  $20^\circ\text{C}$  and  $16^\circ\text{C}$ , the trickling filter efficiency are 78% and 68% respectively.

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