**Code : 011841**

**B.Tech. 8th Semester Exam., 2017**

**Industrial Waste Treatment**

*Time : 3 hours* *Full Marks : 70*

***Instructions :***

*(i) The marks are indicated in the right-hand margin.*

*(ii) There are **Nine** questions in this paper.*

*(iii) Attempt **Five** questions in all.*

*(iv) Questions No. 1 is compulsory.*

1. Objective types questions. Answer any seven. 7×2=14

I. According to Ministry Forest and Environment Notification.1993, BOD of treated wastewater for discharge into surface water body should be less than

a. 10 mg/L

b. 20 mg/L

c. 30 mg/L

d. 0 mg/L

II. The acclimation period of microorganism to new environment is called

a. Stationary phase

b. Lag phase





c. Log-growth phase

d. None of above

III. A shallow earthen basin in which wastewater is retained long enough for natural purification to provide necessary degree of treatment is known as

a. Oxidation pond

b. Oxidation ditch

c. Both

d. None of these

IV. Concentration (mg/L) of mixed-liquor suspended solids (MLSS) for completely mixed reactor is approximately

a. 1500-3000

b. 3000-6000

c. 6000-8000

d. 8000-10000

V. Solids content of a given sample of volume 1 $m^3$ is 1%. What would be the solids content in % if the 50% volume of wastewater is decanted (*without solids escape*) what would be solids content in remaining sample.

a. 0.5%

b. 1%

c. 2%

d. 4%

VI. 2.5 mL of raw sewage has been diluted to 250 mL. What will the BOD5 at 20°C if DO concentration of the diluted sample at the beginning and after 5 days incubation at 20°C of the BOD test are 8 and 5mg/L respectively

a. 100 mg/L

b. 200 mg/L

c. 300 mg/L

d. 400 mg/L

VII. Presence of phosphorous in wastewater may be responsible for

a. High BOD value

b. High COD value

c. Eutrophication

d. All

VIII. Bacteria responsible nitrification may be classified as

a. Aerobic heterotrophic

b. Anaerobic heterotrophic

c. Aerobic autotrophic

d. Facultative





IX. Factors responsible for the growth of filamentous bacteria in ASP

i. High F/M ratio

ii. Low BOD

iii. High DO

iv. Insufficient nutrient

Correct option is

a. i, iii and iv

b. ii and iii

c. ii and iv

d. All

X. An example of fixed film reactor

a. Activated sludge process

b. UASB clarifier

c. Trickling filter

d. None of these

2. (a) What are the methods available for estimation of organic content in industrial wastewater? Discuss in brief.

(b) Water samples were collected from a river which receives untreated wastewater and analyzed for BOD at suitable time interval at 20°C. The results obtained are given below:

| Time, day | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|
| BOD, mg/L | 11 | 18 | 22 | 24 | 26 |

Employing the above data, estimate rate constant, $BOD_5$ and $BOD_{ult}$. 5+9

3. (a) Discuss the various techniques that can be employed to fractionate an industrial wastewater sample.

(b) Discuss the salient features of ion-exchange process and its applicability in industrial processes. 9+5

4. (a) Draw typical wastewater flow diagram incorporating in-line and off-line flow equalization basin.

(b) For the purpose to install a common effluent treatment plant in Hajipur industrial area a preliminary survey was conducted to assess the variation in wastewater flow rate and $BOD_5$ concentration and the same is given below:





| Time Period | Average flow rate during time period, $m^3/s$ |
|---|---|
| M-2 | 0.275 |
| 2-4 | 0.165 |
| 4-6 | 0.105 |
| 6-8 | 0.120 |
| 8-10 | 0.355 |
| 10-N | 0.425 |
| N-2 | 0.425 |
| 2-4 | 0.385 |
| 4-6 | 0.325 |
| 6-8 | 0.330 |
| 8-10 | 0.400 |
| 10-M | 0.345 |

Employing above data determine of volume of in-line equalization basin. 4+10

5. A wastewater treatment plant consists of primary treatment units followed by an activated-sludge secondary system. The primary and secondary sludges are mixed, thickened and send to further treatment. The wastewater, treatment plant and sludge characteristics are as follows:

| Wastewater | | Treatment plant | | Sludge | |
|---|---|---|---|---|---|
| Influent SS | 200 mg/L | Primary clarifier diameter | 25 m | Primary | 5.0 % solids |
| Influent BOD | 225 mg/L | Aeration tank volume | 2900 $m^3$ | Secondary | 0.75% solids |
| Effluent BOD | 20 mg/L | MLSS in aerator | 3500 mg/L | Thickened | 4.0% solids |
| Flow | 19,000 $m^3/d$ | | | | |

Determine the solids loading (kg/d) to the sludge disposal facilities and the per cent volume reduction by the thickener. (Assume efficiency of clarifier for SS removal 60 % and BOD removal = 30%; biomass conversion factor Y=0.4)

6. (a) Define Adsorption process. Discuss in brief the various adsorption isotherm models used for modelling the adsorption experimental data.

(b) Employing Langmuir parameters; b=0.643 and $Q_{max}$ = 0.345, obtained during adsorption of 2-Naphthol onto activated carbon, determine Q at effluent concentration ($C_e$) 0.01, 0.02, 0.04, 0.06 0.08, 0.1, 0.12 mg/L.




7. It is required to upgrade primary treatment plant to a secondary plant employing completely mixed activated sludge process that can meet an effluent standard of 30 mg/L $BOD_5$ and 30 mg/L suspended solids (SS). Assuming that the $BOD_5$ of the SS may be estimated as equal to 63 per cent of the SS concentration, estimate the required volume of the aeration tank. The following data are available from the existing primary plant. Existing plant effluent characteristics:
Flow, Q=15000 $m^3/d$, $BOD_5$=125 mg/L.
Assume the following values for the growth constants:
Ks=100 mg/L $BOD_5$, $k_0$= 2.5 $d^{-1}$, $k_d$ =0.05$d^{-1}$; Y=0.50 mg VSS/mg $BOD_5$.
X=2000 mg/L (MLVSS).

8. (a) With the help of neat sketch describe in brief the various zones of Pollution in a river stream.

(b) A wastewater effluent of 560 L/s with a $BOD_5$= 50 mg/L. DO = 3.0 mg/L and temperature of 23°C enters a river where the flow is 28 $m^3/s$ and BOD5=4.0 Mg/L, and temperature = 17°C. $k_1$ of the waste is 0.10 per day at 20°C. The velocity of water in the river downstream is 0.18 m/s and depth of 1.2 m. Determine the following after mixing of wastewater with the river water: 5+9

a. Combined discharge
b. $BOD_5$
c. DO
d. Temperature

9. Differentiate between vegetable tanning and chrome tanning. Describe in brief the characteristics of tannery wastewater and available treatment options in India.

***