

Thapar Institute of Engineering and Technology, Patiala
Department of Biotechnology and Environmental Sciences
End Semester Examination, EN-103
Unit Processes and Operations- I (Physico-Chemical)

24

Time 3 Hrs

M.M 72

Answers must be brief and to the point.

Assume any missing data by stating the suitable reason.

Question 1. is compulsory and attempt any four from the remaining.

Same parts of a question should be attempted at the one place.

1. Attempt any eight parts. (1.5 x 8 = 12)
 - (a) Draw a typical Incinerator process diagram with all control devices for handling hazardous wastes?
 - (b) Discuss the applications of filters in wastewater treatment. Also give design features of pressure filtration?
 - (c) Differentiate between reverse osmosis and forward osmosis and discuss their applications?
 - (d) What are various methods of chlorination? Explain the procedure of shock chlorination?
 - (e) Write a short note on sludge management?
 - (f) Discuss the principle of cyclones and ESP? Also discuss where they find their applications in environment field?
 - (g) What are the various types of flow meters? Discuss the working of any one type of momentum flow meter?
 - (h) Give the construction and design features of trickling filters?
 - (i) Discuss the applications of software programs in wastewater treatment? Give examples?
 - (j) Discuss the working of membrane bioreactor and give its applications?
 - (k) Enumerate the applications of biotechnology in wastewater treatment?
 - (l) Describe the process of Grit chamber design and give its applications?

2.
 - (a) Define the term terminal/settling velocity? How settling velocity varies in different regions of sedimentation tank?
 - (b) Normally it is advisable to utilize sedimentation tank of high surface area and low depths. Justify the statement with suitable reasons?
 - (c) Comment about carbonaceous and nitrogenous BOD? Also give equations for these?
 - (d) More than a mechanism play a role in the filtration of water - Elaborate.
 - (e) Explain the sequence of steps involved in designing the Zone settling clarifier with given value of underflow solids concentration?

(3, 3, 3, 3, 3)

3. (a) The following samples were collected for a wastewater stream in an Industry:

Sample no.	1	2	3	4	5	6	7	8	9	10
Flow (gpm)	250	215	190	165	155	205	290	330	420	510

If a total composite volume of 4000 ml is required, how many ml of each sample must be taken?

(b) What is the meaning conveyed with the following types of chlorine treatment?

i) Post chlorination ii) Pre chlorination iii) Multiple chlorination

(c) Bag filter is the most suitable device to remove particulates from the gaseous streams – Discuss?

(d) Explain, with the help of flow sheets, possible arrangements of preliminary treatment units in wastewater processes?

(5, 4.5, 3, 2.5)

4. (a) Change in concentration of organic matter L, with time t, is given by:

$$\log_e L = -Kt + C$$

Calculate the organic matter remaining after 4 days if the initial concentration was 300 mg/L and K = 0.3 per day?

(b) How do you determine head loss through bar screens and also write a short note on disposal of screenings?

(c) What do you understand by sedimentation of wastewater? Describe in brief various types of settlings?

(d) Explain the importance of $K_L a$ value during oxygen transfer in wastewater treatment?

(5, 4, 3, 3)

5. (a) Discuss the basic components of a floatation system? How are the basic floatation variables evaluated for the process design?

(b) What are the basic design considerations for flow equalization tank? Explain how volume requirements for the equalization basin are calculated?

(c) Explain the various types of mixers used for rapid mixing in wastewater treatment?

(d) Design a primary settling tank of (i) rectangular shape (ii) circular shape for a town having a population of 50,000, with a water supply of 180 liters per capita per day. Assume that 85% of water supply is converted to sewage. Take overflow rate of $30 \text{ m}^3/\text{d}/\text{m}^2$ for average flow?

(3, 4, 3, 5)

6. (a) What is the role played by the following component parts during the operation of the filters?

i) Troughs ii) Rate control devices iii) Under drains

(b) List out various steps involved in selecting the optimum depth of the limestone bed for neutralization of acidic wastes?

(c) What is the reason and remedy for the following filter troubles?

i) Mudball formation ii) Sand boiling iii) Air binding

(d) What are the factors influencing the performance of chlorine on water and wastewater?

(4.5, 4, 4.5, 2)

7. (a) Design a set of Rapid sand filters for a town having water requirement of 6 Mld.

(b) Chlorine usage in the treatment of 25,000 Cu.m. of water per day is 9 kg/d. The residual chlorine after 10 min. contact is 0.3 mg/l. Calculate the dosage of chlorine applied in mg/l and chlorine demand of water.

(c) Define hardness of water. What are the various types of it? What are its drawbacks in industrial activities?

(d) Discuss the mechanism of oxygen transfer from air bubble to bulk liquid during aeration process in wastewater treatment?

(4, 5, 3, 3)