

**GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR
(GIET UNIVERSITY)**

M.Tech. (Second Semester) Regular Examinations, May - 2026

**24MCHPE12002 - Waste Water Engineering
(Chemical Engineering)**



Time: 3 hrs

Maximum: 60 Marks

**Answer ALL questions
(The figures in the right hand margin indicate marks)**

PART – A

(2 x 5 = 10 Marks)

Q.1. Answer **ALL** questions

- | | CO # | Blooms
Level |
|--|------|-----------------|
| a. Classify and explain the objectives of advanced water and wastewater treatment processes. | CO2 | K1 |
| b. Discuss the different types of hardness present in water and explain their characteristics. | CO3 | K1 |
| c. Explain the various applications and reuse possibilities of treated water after treatment. | CO3 | K2 |
| d. Discuss the important materials commonly selected for membrane fabrication and explain their suitability for membrane design. | CO4 | K1 |
| e. Sketch and explain the chlorine demand curve, indicating important regions such as breakpoint chlorination and residual chlorine formation. | CO4 | K3 |

PART – B

(10 x 5=50 Marks)

Answer **ALL** the questions

- | | Marks | CO # | Blooms
Level |
|---|-------|------|-----------------|
| 2. a. Digester gas produced in wastewater treatment plants can serve as an important energy source. Discuss the different methods available for the utilization of digester gas. | 5 | CO1 | K1 |
| b. Among the following methods, identify and justify the most economical option for transporting sewage sludge for agricultural utilization | 5 | CO1 | K2 |
| i. Wet transport after thickening | | | |
| ii. Removal of sludge directly from sludge basins | | | |
| (OR) | | | |
| c. State and explain the primary objectives of sludge stabilization in wastewater treatment processes. | 4 | CO1 | K1 |
| d. The digestion process in a municipal wastewater treatment plant occurs through four important stages. Name these four phases in the correct sequence and briefly explain each stage. | 6 | CO1 | K2 |
| 3.a. Describe the various bioassay methods used for toxicity assessment of industrial effluents and explain their significance in environmental monitoring. | 5 | CO2 | K2 |
| b. Explain the different measures and treatment steps adopted to control water pollution at its source. | 5 | CO2 | K1 |
| (OR) | | | |
| c. Discuss the different methods used for the removal of heavy metals from contaminated water and wastewater. Explain the principle, advantages, and limitations of each method. | 5 | CO2 | K2 |
| d. Define the equalization process in wastewater treatment and explain why it is considered an important unit operation in achieving efficient and stable treatment performance. | 5 | CO2 | K3 |
| 4.a. What are the advanced treatment processes used in wastewater treatment? Discuss their objectives and significance in improving treated water quality. | 5 | CO3 | K2 |
| b. Explain in detail the construction, working principle, advantages, and applications of a Rotating Biological Contactor (RBC) used in wastewater | 5 | CO3 | K3 |

treatment.

(OR)

- | | | | | |
|------|---|---|-----|----|
| c. | An activated sludge treatment plant with an aeration tank volume of 1350 m ³ operates under the following conditions:
Influent flow rate, $Q = 75 \text{ L/s}$, Influent BOD ₅ concentration = 200 mg/L
Mixed liquor suspended solids in the aeration tank, MLSS = 3.3 g/L
Specific excess sludge production, $ESA = 0.8 \text{ kg DS/kg BOD}_5$
Recirculation ratio, $RR = 1.1$ Based on the above data, calculate:
i) The sludge loading rate of the aeration tank.
ii) The quantity of excess sludge produced per day, QES (m ³ /day). | 6 | CO3 | K1 |
| d. | In aeration tanks, maintaining an adequate oxygen supply for microbial activity is highly important. Explain the factors responsible for variations in oxygen demand in aeration tanks and justify their effects on the aeration process. | 4 | CO3 | K2 |
| 5.a. | Explain the concept of sludge thickening or sludge concentration in wastewater treatment. List the different techniques used for sludge thickening and describe the working of a gravity sludge thickener with the help of a neat sketch. | 5 | CO4 | K1 |
| b. | Nitrogen removal in wastewater treatment plants is achieved through the processes of nitrification and denitrification. Briefly explain these two biological-chemical processes involved in nitrogen removal. | 5 | CO4 | K2 |
| (OR) | | | | |
| c. | State the important objectives of sludge stabilization in wastewater treatment systems. | 4 | CO4 | K1 |
| d. | The digestion of sludge in a municipal wastewater treatment plant occurs in four major stages. Name these four phases in the correct order and briefly explain each stage. | 6 | CO4 | K3 |
| 6.a. | Discuss the various methods available for the utilization of sewage sludge and explain the benefits that can be achieved through its proper use. | 4 | CO4 | K1 |
| b. | Explain the different methods of sewage sludge disposal with special reference to agricultural utilization and sludge incineration. Discuss the technical, environmental, and economic advantages and disadvantages of:
i. Agricultural utilization of sewage sludge
ii. Incineration of sewage sludge | 6 | CO3 | K2 |
| (OR) | | | | |
| c. | Discuss the various methods available for the disposal of sewage sludge in agricultural areas. Which method is generally considered the most economical, and why? Support your answer with technical reasoning. | 4 | CO3 | K1 |
| d. | A wastewater treatment plant has a capacity of 5,000 PT with a wet sludge yield of 0.5 m ³ per PT and year ($\rho = 1.05 \text{ kg/dm}^3$). The dry solid matter content is 4 %. Calculate the minimum surface area requirement in ha for an agricultural utilisation if, according to the Sewage Sludge Ordinance, a maximum of 5 t within 3 years may be applied. | 6 | CO4 | K2 |

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