GUJARAT TECHNOLOGICAL UNIVERSITY

[BE-7 SEMESTER] – OLD PAPER – S22 TO S26 – QUESTION BANK

Subject Name & Code: Industrial Wastewater Pollution and Control- 3171303

Chapter 1: Water Quality Standards for industrial use

Repeated Questions:

1. Water Quality Requirements for Industrial Use:

- **Q.** Discuss the water quality criteria/requirements for boiler feed water and cooling water / basic water quality parameters required for boiler feed water and cooling water. **(SUMMER 2022 OR; SUMMER 2024, 3 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 7 Marks)**

2. Boiler Problems – Scale and Caustic Embrittlement:

- **Q.** What is scale? Explain how it is formed. / How is scale formed in boiler? What problems are caused by it? How can scale formation be prevented? **(SUMMER 2023, 3 Marks; WINTER 2023, 7 Marks; WINTER 2024, 3 Marks; WINTER 2025, 7 Marks)**

3. Pollution Control – Benefits and Costs:

- **Q.** Enlist and explain the primary and secondary benefits of pollution control / industrial waste treatment; categories of benefits; tangible and intangible benefits. **(SUMMER 2022, 3 Marks OR; WINTER 2022, 7 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 7 Marks OR)**

4. Water Conservation, Reuse and Water Sources:

- **Q.** How can we encourage water conservation in an industrial plant? / Enlist different steps of conservation of water in industry. **(SUMMER 2022; WINTER 2022, 3 Marks)**

Other Important Questions:

1. Water Quality Requirements for Industrial Use:

- **Q.** Describe the water quality requirements for various industrial applications such as textile and pharmaceutical industries. **(SUMMER 2026, 7 Marks)**

2. Boiler Problems – Scale and Caustic Embrittlement:

- **Q.** Discuss the causes, mechanism, and prevention of caustic embrittlement in boiler systems. **(SUMMER 2026, 4 Marks)**

3. Pollution Control – Benefits and Costs:

- **Q.** List the factors that make pollution control expensive for industries. **(SUMMER 2026, 3 Marks)**

4. Water Conservation, Reuse and Water Sources:

- **Q.** Differentiate between industrial and domestic wastewater. **(WINTER 2022, 3 Marks)**
- **Q.** Justify the statement: “Treated municipal wastewater can be considered the source of water for industries, which is increasing in quantity and improving in quality.” **(SUMMER 2023, 4 Marks)**

Chapter 2: Standards for disposal into different Sinks

Repeated Questions:

1. Criteria vs Standards; Stream and Effluent Standards:

- **Q.** Differentiate between criteria and standards. **(SUMMER 2022; WINTER 2025, 3 Marks)**
- **Q.** Define/differentiate between stream standards and effluent standards; give at least 6 points of difference; benefits and drawbacks. **(SUMMER 2022; WINTER 2022, 7 Marks OR; SUMMER 2023, 7 Marks OR; WINTER 2023, 3 Marks; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 4 Marks)**

Other Important Questions:

1. Criteria vs Standards; Stream and Effluent Standards:

- **Q.** Explain the benefits and drawbacks of Stream standards. **(WINTER 2025, 4 Marks)**

2. Load-Based, Concentration-Based and Sink-Specific Standards:

- **Q.** Define load based and concentration based standards with example. **(WINTER 2023, 3 Marks)**
- **Q.** Why are there different discharge standards for different environmental sinks? Give your comments. **(SUMMER 2025, 7 Marks)**
- **Q.** List the significant pollutants for the following environmental sinks: (a) Estuary (b) River (c) Sewer (d) on land. **(SUMMER 2024, 4 Marks)**
- **Q.** Write full form of SAR and explain its significance while discharge of effluent on land. **(SUMMER 2024, 3 Marks OR)**

3. Population Equivalent (Numerical):

- **Q.** Calculate population equivalent considering per capita BOD_3 at 27°C contribution as 50 g/d for an industry discharging 180 m^3/d of effluent with BOD_3 at 27°C of 250 mg/L. **(SUMMER 2024, 3 Marks)**

Chapter 3: Concepts of disposal of wastewater into different sinks (river, lake, oceans)

Repeated Questions:

1. Self-Purification of Streams:

- **Q.** Explain self-purification of water body/streams; enlist and explain factors affecting self-purification capacity; "Self purification capacity is different of each stream" — justify. **(SUMMER 2022; WINTER 2022, 4 Marks; SUMMER 2023, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 7 Marks; WINTER 2025, 4 Marks OR)**

2. DO Sag Curve and Dissolved Oxygen (Theory):

- **Q.** Draw/explain DO sag curve; define DO deficit; write equations of DO deficit, DO of mix and critical time; Streeter–Phelps equation. [Diagram required – refer to the original question paper] **(SUMMER 2022; SUMMER 2024, 7 Marks; SUMMER 2025, 3 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 7 Marks; SUMMER 2026, 7 Marks OR)**

3. Lakes – Stratification, Classification and Eutrophication:

- **Q.** Explain stratification and overturn of lakes / characteristics of different zones of lake under stratification / limnology and deep lake showing vertical stratification. [Diagram required – refer to the original question paper] **(SUMMER 2022; WINTER 2022, 3 Marks; SUMMER 2023, 4 Marks; WINTER 2023, 3 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks OR)**
- **Q.** Give classification of lakes based on productivity / explain different zones of lake based on biological activity. **(SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Derive the equation $C_e = W / V\beta$ for lake / steady-state concentration of pollutant in a lake. **(SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks OR)**

4. Disposal into River, Land, Ocean and Sewer:

- **Q.** Enlist fundamental considerations for disposal of wastewater into river / points to be considered while selecting river/stream as sink. **(SUMMER 2022; SUMMER 2024, 4 Marks; WINTER 2025, 7 Marks)**
- **Q.** Enlist and explain important points to be considered while selecting land as ultimate point of effluent discharge / points while discharging effluent on land. **(SUMMER 2023, 7 Marks; WINTER 2023, 4 Marks; WINTER 2024, 7 Marks OR)**
- **Q.** Method of disposal of effluent into ocean / points to be considered while ocean is chosen as ultimate point of disposal. **(SUMMER 2022 OR; WINTER 2022 OR; SUMMER 2025, 3 Marks)**

Other Important Questions:

1. DO Sag Curve and Dissolved Oxygen (Theory):

- **Q.** Identify the sources and sinks of DO in the river. **(WINTER 2023, 4 Marks)**

2. DO Sag – Numerical Problems:

- **Q.** Secondary effluent from STP is discharged into a stream. The wastewater flow is 0.12 m^3/s and has a BOD_5 of 20 mg/L. The temperature and DO of wastewater are 25°C and 6.5 mg/L. The water quality of stream just upstream of discharge point is Qr = 0.3 m^3/s, DO = 7.9 mg/L, BOD_5 = 3 mg/L and temperature = 21°C. kd = 0.23 d^{-1} and kr = 0.45 d^{-1} at 20°C. The temperature coefficients for deoxygenation and reaeration are 1.12 and 1.024 respectively. Calculate critical DO. DO saturation at 22°C = 8.74 mg/L. **(SUMMER 2023, 7 Marks)**
- **Q.** A wastewater treatment plant discharges 2 m^3/s of treated water having ultimate BOD of 50 mg/L and DO of 2 mg/L into a stream. The stream has a flow of 10 m^3/s, ultimate BOD of 5 mg/L and DO of 8 mg/L. Assuming complete and instantaneous mixing, estimate: (a) ultimate BOD of river just downstream of outfall (b) initial DO deficit (c) if the stream has a constant speed of 0.3 m/s, estimate the BOD remaining of the stream at a distance of 30 km from discharge (d)

determine the critical time at which minimum DO occurs and its distance from point of discharge. kd = 0.3 day^{-1} and kr = 0.7 day^{-1}. Assume DO saturation = 9.05 mg/L. **(WINTER 2022)**

- **Q.** A city is discharging its wastewater in a river. Find whether the wastewater should be discharged in the river or not as per state standards of 5 mg/L of DO level at a point of 5 km downstream of discharge. Saturated DO at 28°C = 7.92 mg/L. Relevant data: Flow, m^3/s: Wastewater 0.28, River 0.877; Ultimate BOD at 25°C: Wastewater 6.44, River 7.0; DO, mg/L: Wastewater 1.00, River 6.0; kd at 28°C: Wastewater NA, River 0.199; kr at 28°C: Wastewater NA, River 0.37; velocity: Wastewater NA, River 0.65; temperature: Wastewater 28°C, River 28°C. **(WINTER 2022 OR)**
- **Q.** A factory is discharging wastewater to a river. Characteristics of river water and wastewater: Flow = 0.56 / 0.17 m^3/s; Temperature = 15 / 30°C; Ultimate BOD = 10 / 60 mg/L; DO = 7 / 2 mg/L. Assume kd = 0.17/d at 20°C with temperature correction coefficient 1.056; kr = 0.30/d at 20°C with coefficient 1.024; average water velocity downstream of mixing point = 8 km/d; saturated DO = 10.1 mg/L. Determine DO concentration at mixing point and critical point in the river. **(WINTER 2024, 7 Marks)**
- **Q.** A city discharges 95 MLD of domestic sewage into a stream with a typical flow of 600 MLD. The ultimate BOD of domestic sewage is 180 mg/L while that of stream is 1.0 mg/L. The DO of wastewater is 0 while that of river is 9.2 mg/L. Calculate the critical DO deficit in the stream. Assume temperature of river and sewage both 20°C, saturation DO at 20°C = 10.1 mg/L, Kd = 0.197 d^{-1} and Kr = 0.587 d^{-1}. **(WINTER 2025, 7 Marks)**

3. Lakes – Stratification, Classification and Eutrophication:

- **Q.** Name the method used for determination of depth of lake. Explain the procedure. **(SUMMER 2024, 4 Marks OR)**
- **Q.** Highlight the consequences if disposal standards are not followed for disposal of wastewater in lake. **(SUMMER 2022 OR)**
- **Q.** Differentiate between lake and river. **(WINTER 2022, 7 Marks)**
- **Q.** Explain how phosphorus balance influences eutrophication in lakes. **(SUMMER 2026, 4 Marks)**

4. Disposal into River, Land, Ocean and Sewer:

- **Q.** Under which circumstances would sewer disposal be selected as an environmental sink? **(WINTER 2023, 3 Marks)**

5. River Pollution and Its Effects:

- **Q.** What are the different zones of pollution in river? Explain with neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks OR)**
- **Q.** What is meant by industrial water pollution? Describe what happens when wastewater from industries is discharged into nearby stream. **(SUMMER 2025, 4 Marks)**

Chapter 4: Oil Pollution and its removal technologies

Repeated Questions:

1. Oil Pollution – Sources, Forms and Effects:

- **Q.** Enlist/explain sources of oil pollution/oily wastes in industries and effects of oil pollution. **(SUMMER 2022; WINTER 2022, 3 Marks OR; SUMMER 2023, 3 Marks OR; WINTER 2023, 7 Marks; WINTER 2024, 4 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)**
- **Q.** Enlist the forms of oil along with concentration / tabulate characteristics of each form. **(SUMMER 2022, 4 Marks OR; WINTER 2022, 4 Marks; WINTER 2023, 7 Marks)**

2. Oil Removal Equipment:

- **Q.** Explain oil and grease trap with neat sketch; working, applications, advantages and disadvantages. [Diagram required – refer to the original question paper] **(SUMMER 2023; SUMMER 2024, 7 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 4 Marks)**
- **Q.** Write a note on API separator with neat sketch; types of oil separator; applications. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks; SUMMER 2023 OR; WINTER 2023, 7 Marks OR; SUMMER 2024, 7 Marks OR)**
- **Q.** Distinguish between oil and grease trap and oil skimmer / working of oil skimmers and oil & grease traps. **(WINTER 2022, 4 Marks OR; SUMMER 2026, 4 Marks)**

3. Flotation Processes:

- **Q.** Floatation / DAF / IGF / mechanical air flotation / nozzle and column flotation. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks; WINTER 2023, 4 Marks OR; SUMMER 2024, 3 Marks; SUMMER 2025, 4 Marks; SUMMER 2026, 7 Marks; SUMMER 2026, 3 Marks OR)**

Other Important Questions:

1. Oil Pollution – Sources, Forms and Effects:

- **Q.** Differentiate between free oil and emulsified oil. **(WINTER 2024, 4 Marks)**

2. Oil Removal Equipment:

- **Q.** Write a short note on Parallel Plate Separator removal technology for oil and grease from wastewater. **(SUMMER 2025, 4 Marks OR)**
- **Q.** Enlist equipments used to remove oil and grease from wastewater. Explain any one with neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2022, 7 Marks OR)**

Chapter 5: Volume & Strength reduction in industrial wastewater

Repeated Questions:

1. Strength Reduction:

- **Q.** What is strength reduction? Highlight its need. Enlist and explain methods/techniques of strength reduction; equipment modification; segregation; process change examples. **(SUMMER 2022 OR; WINTER 2022, 4 Marks; SUMMER 2023, 3 Marks; SUMMER 2023, 3 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks OR; SUMMER 2026, 7 Marks OR)**

2. Volume Reduction:

- **Q.** What is volume reduction? Enlist and explain techniques/methods of volume reduction with examples; highlight need of volume reduction. **(SUMMER 2022 OR; WINTER 2022, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 7 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 7 Marks OR)**

Other Important Questions:

1. Wastewater Strength:

- **Q.** Define wastewater strength and list the parameters used to measure it. **(SUMMER 2026, 3 Marks OR)**

2. Water Balance, Recycling and Reuse:

- **Q.** What is the importance of water balance diagram for industry? **(SUMMER 2022)**
- **Q.** Explain why there is a need to recycle and reuse the wastewater. **(SUMMER 2025, 3 Marks OR)**

Chapter 6: Pre and Primary treatment for industrial wastewater

Repeated Questions:

1. Equalization:

- **Q.** Explain equalization along with its purpose/importance/benefits in industrial ETP. **(SUMMER 2022 OR; WINTER 2022, 3 Marks OR; SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 4 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Enlist methods of mixing in equalization basin; explain any one with neat sketch. [Diagram required – refer to the original question paper] **(WINTER 2022, 4 Marks; WINTER 2023, 4 Marks OR; SUMMER 2026, 4 Marks OR)**

2. Proportioning:

- **Q.** What is proportioning? Objectives/need/purpose of proportioning of industrial wastes. **(SUMMER 2023, 4 Marks OR; SUMMER 2024, 4 Marks OR; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks OR; SUMMER 2026, 4 Marks OR)**

3. Neutralization:

- **Q.** Neutralization of wastewater: purpose, methods, seven major methods for acid and alkaline wastes, limestone treatment, CO_2 method. **(SUMMER 2023, 4 Marks; WINTER 2023, 7 Marks OR; SUMMER 2024, 3 Marks; WINTER 2024, 3 Marks OR; SUMMER 2025, 4 Marks OR; WINTER 2025, 3 Marks OR)**

Other Important Questions:

1. Heavy Metal Removal:

- **Q.** Explain the process of removal of heavy metals from the wastewater. **(WINTER 2025, 4 Marks)**

Chapter 7: Common Effluent Treatment Plants (CETP)

Repeated Questions:

1. CETP – Concept, Need and Benefits:

- **Q.** CETP: concept, need, objectives, benefits/advantages/importance over end-of-pipe treatment. **(SUMMER 2022; WINTER 2022, 4 Marks; WINTER 2022, 3 Marks OR; SUMMER 2023, 4 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 4 Marks; WINTER 2024, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**

2. CETP – Planning, Treatment Technologies and Conveyance:

- **Q.** List factors that influence proper planning and operation of CETPs. **(WINTER 2022, 3 Marks; WINTER 2023, 3 Marks)**
- **Q.** Enlist treatment technologies adopted at CETP and explain importance of each unit. **(SUMMER 2022; SUMMER 2025, 7 Marks OR)**
- **Q.** Explain types of conveyance systems for transporting wastewater to CETP / note on conveyance system / design considerations. **(SUMMER 2023; WINTER 2024, 3 Marks OR; WINTER 2025, 3 Marks; SUMMER 2026, 4 Marks)**

3. CETP – Operational Problems:

- **Q.** CETP limitations/constraints/problems in operation and how to overcome them. **(SUMMER 2025, 3 Marks OR; WINTER 2025, 4 Marks OR; SUMMER 2026, 3 Marks)**

Other Important Questions:

1. Industry Discharge to Sewers and Industry Types:

- **Q.** Can an industry discharge its effluents into municipal sewers? What are the points to be kept in mind? **(WINTER 2024 OR)**
- **Q.** Differentiate between homogeneous and heterogeneous industries. **(WINTER 2023, 3 Marks OR)**

Chapter 8: Treatment for strong industrial waste

Repeated Questions:

1. Thermal Treatment and Incineration:

- **Q.** Objectives/thermal treatment methods for high strength wastewater; explain any one in detail. **(WINTER 2022, 3 Marks; SUMMER 2023, 7 Marks; WINTER 2023, 3 Marks; WINTER 2024, 7 Marks; SUMMER 2026, 7 Marks)**
- **Q.** Incineration: purpose, conditions required, operational problems, characteristics required, incinerator operation with neat sketch. [Diagram required – refer to the original question paper] **(SUMMER 2022; SUMMER 2024, 4 Marks OR; WINTER 2025, 3 Marks OR; SUMMER 2026, 3 Marks OR; SUMMER 2026, 7 Marks OR)**

2. Evaporation and Multi-Effect Evaporators:

- **Q.** Multi-effect evaporator / multi-effect distillation: note with neat sketch, construction and working. [Diagram required – refer to the original question paper] **(SUMMER 2023, 7 Marks OR; WINTER 2023, 7 Marks; WINTER 2025, 7 Marks OR)**
- **Q.** Evaporation: need, natural and forced evaporation, evaporation pond. **(SUMMER 2022; SUMMER 2024, 3 Marks OR; SUMMER 2025, 4 Marks OR; SUMMER 2026, 3 Marks)**

3. Sources of High-Strength Wastewater:

- **Q.** Prepare a list of sources of high strength wastewater along with parameters. **(SUMMER 2023 OR; WINTER 2023, 3 Marks OR)**

Other Important Questions:

None identified.

Chapter 9: Pollution Control in Industries

Repeated Questions:

1. Dairy Industry:

- **Q.** Dairy / milk processing industry: sources of wastewater, characteristics of each waste stream, ETP scheme/flow diagram. [Diagram required – refer to the original question paper] **(SUMMER 2022; SUMMER 2023 OR; WINTER 2024, 4 Marks)**

2. Tannery Industry:

- **Q.** Tannery industry: operation sequence, sources of wastewater, manufacturing process, treatment plant. [Diagram required – refer to the original question paper] **(SUMMER 2023; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks)**

3. Pulp and Paper Industry:

- **Q.** Pulp and paper industry: manufacturing process, sources of wastewater, treatment scheme/flow diagram/ETP scheme. [Diagram required – refer to the original question paper] **(SUMMER 2022 OR; WINTER 2022, 7 Marks; WINTER 2024, 4 Marks OR; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks)**

4. Sugar Industry:

- **Q.** Sugar industry: sources/block diagram; treatment technological options and merits/demerits. [Diagram required – refer to the original question paper] **(WINTER 2022, 7 Marks OR; WINTER 2025, 4 Marks)**

5. Starch Industry:

- **Q.** Starch industry: sources of wastewater generation and treatment flow diagram. [Diagram required – refer to the original question paper] **(SUMMER 2024, 7 Marks OR; WINTER 2024, 7 Marks OR)**

6. Textile Industry:

- **Q.** Textile industry: wastewater characteristics, treatment plant; cotton textile manufacturing, sources and treatment scheme. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks OR)**

Other Important Questions:

1. Other Industries and Pollutant Characteristics:

- **Q.** Prepare a list of industries as per mentioned characteristic of wastewater: (i) high BOD, (ii) high BOD/COD ratio, (iii) low BOD/COD ratio. **(SUMMER 2024, 3 Marks)**
- **Q.** Explain the major types of pollutants generated from dye and dye intermediate industries. **(SUMMER 2026, 4 Marks)**
- **Q.** Discuss the wastewater treatment process in pharmaceutical industries and explain how recycling and reuse can be implemented. **(SUMMER 2026, 4 Marks OR)**

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