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Question Paper Code: R9402

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Third Semester

Chemical Engineering

R21CHV402 – WASTEWATER TREATMENT

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. What is the primary goal of wastewater treatment? CO1-U
(a) To increase water salinity (b) To remove pathogens and pollutants
(c) To evaporate all water (d) To increase BOD in effluent
2. What is the typical pH range of municipal wastewater? CO1-U
(a) 3.0–4.5 (b) 4.5–6.0
(c) 6.5–8.5 (d) 9.0–11.0
3. What is the primary purpose of screening in a wastewater treatment plant? CO1-U
(a) Adjust pH (b) Remove fine dissolved solids
(c) Remove large floating debris (d) Disinfect the water
4. Equalization in wastewater treatment is used to: CO1-U
(a) Kill bacteria (b) Remove heavy metals
(c) Balance flow and pollutant load variations (d) Increase water temperature
5. Which of the following best describes the *log phase* of bacterial growth? CO1-U
(a) No increase in cell number
(b) Rapid cell division and exponential growth
(c) Decrease in cell number due to nutrient depletion
(d) Genetic adaptation to the new environment

6. The Monod equation is used to describe the relationship between: CO1-U
- (a) Substrate concentration and enzyme activity
 - (b) Bacterial growth rate and substrate concentration
 - (c) pH and microbial metabolism
 - (d) Temperature and growth inhibition
7. Which adsorbent is most commonly used in advanced wastewater treatment? CO1-U
- (a) Zeolite (b) Silica Gel
 - (c) Activated Carbon (d) Alum
8. Ion exchange is mainly used to remove _____. CO1-U
- (a) Suspended solids (b) Dissolved salts (hardness ions)
 - (c) Colloids (d) Gases
9. The semi-solid byproduct obtained from wastewater treatment plants is called _____. CO1-U
- (a) Slurry (b) Sludge
 - (c) Effluent (d) Residue
10. The first step in sludge treatment, which increases solids concentration by removing excess water, is called _____. CO1-U
- (a) Dewatering (b) Thickening
 - (c) Conditioning (d) Stabilization

PART – B (5 x 2= 10 Marks)

11. In a food processing plant, oil and grease are present in the wastewater. Which unit process would you apply for removal, and why? CO1-U
12. Why is neutralization important in chemical treatment of wastewater? CO2-App
13. Given a site with limited land availability, apply your knowledge to choose between an attached growth and a fluidized bed anaerobic system. Justify your selection. CO2-App
14. Why is removal of both nitrogen and phosphorus necessary in wastewater treatment? CO3-Ana
15. Differentiate between sludge stabilization and conditioning. CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) Discuss the physical, chemical, and biological characteristics of wastewater. CO1-U (16)
- or
- (b) Explain the major categories of pollutants in wastewater. Describe their sources and impacts. CO1-U (16)
17. (a) Design a complete flow diagram for a physical and chemical treatment system for an industrial wastewater plant. CO2-App (16)
- Or
- (b) Develop a aeration system for a municipal wastewater treatment plant. CO2-App (16)
18. (a) A rural municipality with limited budget needs a low-maintenance aerobic treatment system. Compare trickling filters and rotating biological contactors (RBCs) and recommend the more suitable option. Apply process understanding to justify your choice in terms of cost, efficiency, operation, and biofilm formation. CO2-App (16)
- Or
- (b) Apply Monod kinetics and microbial growth phases (lag, log, stationary) to a real-world challenge and recommend control strategies. CO2-App (16)
19. (a) Analyze and compare the working principles, advantages, and limitations of SBR, SBBR, MBR, and MBBR systems and write any one system in detail. CO3-Ana (16)
- Or
- (b) Analyze the process of Ion Exchange in advanced wastewater treatment with respect to principle, types of resins, applications, advantages, limitations, and comparison with adsorption. CO3-Ana (16)
20. (a) Describe the process of sludge thickening. Why is it considered the first step in sludge treatment. CO1-U (16)
- Or
- (b) Explain sludge stabilization methods. Why is stabilization important before final disposal. CO1-U (16)

