

“Please check whether you have got the right question paper.”

Candidates to adhere to the following instructions, while answering the questions.

- i) Question No. 1 Section A and Question No.6 of Section B are compulsory.
- ii) Answers any two Question among the remaining Questions (i.e., 2to5) of Section A and any two questions (i.e., 7 to 10) of section B.
- iii) Assume suitable data, if required, clearly stating the relevant assumption made.
- iv) Neat diagrams must be drawn wherever necessary.

SECTION-A

- Q.1 Answer the following questions : 10
- a) Distinguish between Self Cleaning Velocity and Non-Scouring Velocity.
 - b) Differentiate between,
 - i) Sewage and Sullage.
 - ii) DWF and WWF.
 - c) BOD of a sewage incubated for 3 day at 20°C was measured 110 mg/L. Calculate BOD_5 at 20°C. Consider $k=0.23$ per day (base) and temperature coefficient = 1.047
 - d) What is the purpose of grit removal in waste water treatment?
 - e) What is the total allowable rate of infiltration in 2000 m long, 200mm diameter lateral sewer if 45 L/d/mm/km is acceptable?
- Q.2 a) How will you test the newly laid sewer lines? 05
- b) A catchment is having total area of 60 hectares. The rainfall intensity relation with duration for this catchment is given by the relation $I = 100/(t+20)$, Where I is in cm/h and t is duration of rain in min. 10
- (a) What will be the storm water runoff from this catchment if the average imperviousness factor is 0.64, and time of concentration is 35 min?
 - (b) If population density of the area is 350 persons per hectare and water consumption is 180 LPCD, what will be the design discharge for separate system and combined system?
- Q.3 a) Determine the concentration of total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), and volatile suspended solids (VSS) in 50 ml of wastewater based on data given; 10
- i) Mass of dry dish = 53.5433 g
 - ii) Mass of dry dish + residue after drying at 105 °C = 53.5794g
 - iii) Mass of dry dish + residue after ignition at 550°C = 53.5625g
 - iv) Mass of whatman GF/C filter = 1.5433g
 - v) Mass of whatman GF/C filter + residue after drying at 105°C = 1.5554g
 - vi) Mass of Whatman GF/C filter + residue after ignition at 550°C = 1.5476g
- b) Draw a curve for BOD exerted and remaining with respect to time for organic wastewater and mathematical expression for both. 05
- Q.4 Write in brief about the following. 15
- a) Design criteria for Grit chamber
 - b) Sewage sampling
 - c) Population equivalent
 - d) Limitations of BOD test
 - e) Design criteria for Bar screen chamber
- Q.5 a) What are sewer appurtenances? Describe the functions of different types of sewer appurtenances used in sewerage system. 06
- b) What is the purpose of primary Sedimentation (PS)? What are the design parameters of PS? 05

- c) Distinguish between the following bacteria : 04
- i) Aerobic bacteria
 - ii) Anaerobic bacteria
 - iii) Facultative bacteria
 - iv) Autotrophic bacteria

SECTION-B

- Q.6 Answer the following questions: 10
- a) Expand the following abbreviations .
 i)UASB ii)MCERT iii) RBC iv)MLVSS
 - b) Name the treatment unit / natural system where the following process occurs
 i) compression setting ii) symbiotic metabolism
 iii) Sloughing of biofilms iv) Methanogenesis.
 - c) The initial volume mass of solid waste is $15m^3$. After compaction, the volume is reduced to $3m^3$.
 Compaction ratio.
 - d) Draw the Monod curve and write the equation .
 - e) Calculate the air required in aeration tank of Activated Sludge Process (ASP) to treat a wastewater having an oxygen demand of 1266 kg/day. Take the efficiency of transfer as 10 percent.

- Q.7 Compare the area required for treating a wastewater flow of $3550 m^3$ /day by facultative pond system and an activated sludge system . The influent BOD_5 following primary clarification is 200mg/L. For pond system , the reaction rate coefficient at $30^\circ C$ is 0.35/day The operating temperature in winter is $10^\circ C$. The pond is expected to operate at a dispersion factor of 0.5 Assume a single cell pond system with 85% removal of soluble BOD for a pond depth of 0.2m .Assume $\Theta=1.06$. For Activated sludge process, take $Y= 0.06kg/kg$, $k_d =0.05per/day$, MCRT =15 days, MLVSS= 3000mg/ L, return –sludge concentration = 10000mg/L of suspended solids (SS)and dept of pond is 5m. Also determine recirculation ratio and volume of sludge wasted
 Note: Determine the primary and secondary setting tank areas for the ASP system and compare the combined area to that of the pond system 15

- Q.8 a) Discuss the removal mechanisms in Waste stabilization and an aerated lagoon using sketches and highlight the difference between the two. 09
- b) What is meant by sludge bulking ? How is the SVI related to bulking ? How may bulking be controlled? 06

- Q.9 a) Design an UASB reactor for treatment of 4 MLD sewage having BOD of 200 mg/L and COD OF 500 mg/L. The average minimum temperature in summer is $35^\circ C$ The wastewater contains 80 mg/L sulphate . Take HRT =10 hours: Range for OLR =1to3 kg COD / m^3 . Day ; Range for SLR =0.1 to 0.3 kg COD/kg VSS /day . Assume VSS in reactor sludge = 25g/L . Assume sludge in effluent to be 100 mg/L; 09
- b) Brief explain the criteria for selection of mechanical equipments used for wastewater treatment . 06

- Q.10 a) What is recovery and recycling of solid waste ? List out the operations involved in recycling ? 04
- b) Name the six characteristics of the waste because of which any waste can be classified as hazardous waste (regardless of their concentration limits) . 06
- c) What is composting ? Discuss Various processes and phases of composting . Write about various factors which affect composting. 05