Final Assessment Test – April 2019

VIT
Vellore Institute of Technology

Course: CLE1006 - Environmental Engineering
Class NBR(s): 5146/5168
Time: Three Hours

Slot: E1
Max. Marks: 100

PART – A (8 X 5 = 40 Marks)

Answer ALL Questions

1. Which type of wastewater management system will you adopt, when the individual houses are scattered over a large area? What are the pros and cons associated when adopting such system?
2. What do you mean by reactor? List various types of reactor and explain its Unit operations and unit processes involved in water and wastewater treatment.
3. Design a slow sand filter to treat a flow of 1000 m^3/day. Assume necessary data.
4. In a jar test it has been found that optimum coagulant dosage is found to be 60 mg/L, 38 mg/L, and 22 mg/L for SA, LPAC, and PPAC respectively. If the plant capacity is 15 MLD (Million Liter per Day) determine the daily consumption of those chemicals in the plant.
5. Draw a flow chart of wastewater treatment system and mention the objectives of each treatment units.
6. Discuss why the following processes are being carried out during wastewater treatment.
   a) Return activated sludge in aeration tank
   b) Recirculation in trickling filter
7. What do you mean by self-purification? When waster is discharged into river, what are various actions involved during the process of self-purification?
8. Discuss the following contemporary issues associated with wastewater treatment.
   a) Energy consumption
   b) Staffing
   c) Environmental foot print

PART – B (5 X 12 = 60 Marks)

Answer any FIVE Questions

9. a) The present population of a city is 1.75 million and the decadal growth rate is of 15%. How many years will it take to double the population at that growth rate? **[4]**

   b) The population of a city in three consecutive decades of 1991, 2001 and 2011 are 14, 18, and 24 million respectively. Find the predicted population for 2025 as per the Logistic Curve Method. **[8]**

10. Compare the total volume requirements for the following reactor systems:
    a) Single CFSTR
    b) Two CFSTRs connected in series
    c) PF reactor

$C_2 = \frac{C_0}{(1+Kt)^2}$

It is desired that the reactant concentration be reduced from 100 mg/L to 20 mg/L for a flow of 1 MLD. Assume that first-order kinetics is followed and the constant has a value of 0.8/day.

11. a) A water treatment plant has a flow rate of 0.3 m^3/sec. The settling basin at the plant has an effective settling volume that is 20 m long, 3 m tall and 6 m wide. Will particles that have a settling velocity of 0.002 m/sec be completely removed? If not, what percent of the particles will be removed? For 100% removal what will be the modified dimension of the basin? [6]

b) How settling can be classified based on the characteristics and concentration of suspended particles? Explain with neat sketch. [6]

12. An effluent 4800 m^3/day flow rate to be disinfected at the level of 99.9% through chlorine. Find the Ct value of the chlorine on the basis of following observation. Laboratory study shows that the concentration of 1.2 mg/L of free available chlorine yield 99.4% kill of microorganism in 15 mins. Assume that Chick's Law and Watson's Law hold with n=1.

13. A rectangular grit chamber is designed to remove particles with a dia of 0.2 mm, specific gravity 2.65. Settling velocity for these particles are 0.022 m/sec, depending on their shape factor. A flow through velocity of 0.3 m/sec will be maintained by proportioning weir. Determine the channel dimensions for a maximum wastewater flow of 10,000 m^3/day.

14. Calculate the BOD loading, hydraulic loading, BOD removal efficiency, and effluent BOD concentration of a single-stage trickling filter based on the following data:

Design assumptions:

Influent flow =1530 m^3/d

Recirculation ratio = 0.5

Primary effluent BOD = 130 mg/L

Diameter of filter = 18 m

Depth of media = 2.1 m

Water temperature =18° C

15. A DAF is been used for thickening of WAS of TSS 9900 mg/L. The flow is 700 L/min. The diameter of DAF is 15 m. The thickened sludge and final effluent are having solid content 5% and 210 mg/L respectively. The air is supplied at 310 l/min. Use 1.2 gm of air per litre of air. Find out the

a) Hydraulic loading rate

b) Solid loading rate

c) Air to solid ratio

d) Concentration factor

e) Solid removal efficiency

⇔⇔⇔