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Total No. of Questions : 08

### M.Tech. Civil Engg. (2016 Batch)   (Sem.–2)
WATER QUALITY MODELING
Subject Code : MTCE-206
Paper ID : [74299]

Time : 3 Hrs.   Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :
1. **Attempt any FIVE questions out of EIGHT questions.**
2. **Each question carries TWENTY marks.**

1. a) Differentiate between effluent limited and water quality limited streams.

    b) Explain how do you propose water quality standards for your area? What are the studies you will conduct to collect the basic data required to set the standards?

2. a) Derive the equation for overall rate of reaction for the generalized reaction.

$$aA + bB \rightarrow cC + dD$$
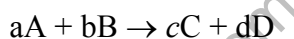
    Show that the ratio of rates of reaction must be equal to the ratio of the stoichiometric coefficients.

    b) Derive and plot the reaction rate for saturation type reaction (enzyme kinetics).

3. a) Develop a box model for transient analysis of an environmental system.

    b) Determine the effect of recycle on the performance of a CFSTR for any type of reaction.

4. a) Using a BOD progression curve, explain how the ultimate BOD of a sample of wastewater is estimated. Explain also how the reaction rate constant can be estimated.

    b) Suppose a pond water contains 15 mg/L of some algae which can be represented by the chemical formula $C_6H_{15}O_6N$. Develop the stochiometric expressions of oxidation of the same and find :

    i) Theoretical carbonaceous oxygen demand.

    ii) The total (carbonaceous and nitrogenous) oxygen demand.

5. From the basic principles, develop Streeter-Phelps equation to represent oxygen sag curve in a river. Sketch and explain the uses of the model for river quality management.

6. a) An accidental spill of liquid organic waste into a lake resulted in an initial concentration of 120 mg/L Volume of the lake is 10^5 m^3. A stream which flows into and out of the lake has a flow rate of 1500 m^3/d. Assume that the waste undergoes first order photochemical decay with a k value of 0.004 d^{-1}. Determine the time required for the concentration in the lake to get reduced to 30 mg/L.

    b) Explain the concept of thermal stratification and DO stratification in receiving water bodies. Discuss its importance.

7. a) Draw and explain a simplified conceptual ecological model for lake system.

    b) Discuss the experimental procedure to trace the groundwater plume in a contaminate aquifer.

8. a) Explain and derive the Dupuit-Forchheimer theory of free surface flow as applied to ground water flow.

    b) Explain the model used to represent the transport of non-reactive contaminants in groundwater.