Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1721806 **Date: 05-06-2013**

Subject Name: Environmental Modeling

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q-1(a) A waste water treatment plant discharge treated sewage into a stream. The characteristics of effluent are **10**

(i) Flow rate: 15000 m^3/day
(ii) BOD_5: 10 mg/l
(iii) Temperature: 25ºC
(iv) The bottle decay coefficient of the CBOD : 0.2/day

The stream characteristics upstream of the point of discharge are as follows

(i) Flow rate : 0.2 m^3/sec
(ii) Velocity u : 0.2 m/sec(stream flow plus treated sewage)
(iii) Re aeration constant kr: 2.6/day
(iv) BOD_5: 3mg/l
(v) DO: 8.0 mg/l
(vi) Temperature: 22ºC
(vii) In stream decay coefficient for CBOD: 0.3/day

Find DO concentration at 5 km distance from the point of discharge.

Q-1(b) Using the stream characteristics of the stream [as given above in (a)] calculate the effluent limitations for a discharge of 20,000 m^3/day. Assume that the water quality standard for DO is 5mg/l. **04**

Q-2(a) Define and explain the concept of "control volume" in the mass balance equation. **07**

Q-2(b) Define and explain with the help of example: **07**

(i) Conservation of matter
(ii) Conservation of energy
(iii) Conservation of matter and energy

OR

Q-2(b) (i) Write and explain the mass balance equation with reference to time factor. **07**
(ii) Define the complete mix and plug flow system.

Q-3(a) Given below are the details of a lake showing signs of eutrophication. **10**

(i) Annual rain fall is 0.25 m with a phosphorus concentration of 0.02 mg/l
(ii) Evaporation from lake 0.7m
(iii) Runoff to the lake is 0.25 m per year
(iv) A total of 3.8 m^3/s of water is withdrawn from lake for water supply (70% of it is returned to the lake with an added amount of P is 2.0 mg/l.)
(v) Phosphorous loss to sediments is first order process with a constant 0.003/day

If the surface area of lake is 100 km^2 and average depth is 15m, estimate the phosphorous loading due to run off.

Q-3(b) With the help of neat diagram explain the following **04**

(i) Batch reactor operation (ii) Plug flow reactor

OR

Q-3(a) Define the following terms **06**

(i) Rate (iv) Conservative pollutant
(ii) Reactive chemicals (v) Steady state condition
(iii) Advection (vi) Diffusion

Q-3(b) Write explanatory note on the following **08**

(i) Waste load allocation – An approach to maintain the water quality
(ii) River segmentation and its importance in river modeling

Q-4(a) Write the mass balance equation for an ideal 1-D plug flow stream under steady state conditions with a first order decaying substance (e.g BOD). Solve for the concentration as a function of concentration at x=0, the rate constant k_d, longitudinal distance x, and mean velocity u. Assume the rate constant for BOD decay is 0.2 d^{-1}, the mean velocity of the stream is 0.5 m sec and the initial concentration is 100mg/l at x=0.Plot the resulting concentration with downstream distance x in KM. **10**

(b) Define the following terms **04**

(i) State variable (iii) Calibration
(ii) Verification (iv) Simulation

OR

Q-4(a) With the help of a neat diagram, explain the key elements in a mass balance. **06**

Q-4(b) Enlist and explain the possible actions that may occur when a substance enters a control volume. **06**

Q-4(c) Define" environmental modeling" **02**

Q-5(a) Enlist and explain the importance of conventional pollutants. **08**

Q-5(b) Define and describe **06**

(i) Grey model
(ii) Conceptual model
(iii) Empirical model

OR

Q-5 Write an explanatory note on **14**

(i) The need and importance of environmental modeling
(ii) The limitations of environmental modeling

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