Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–II • EXAMINATION – SUMMER - 2017

Subject Code: 2721806 **Date: 29/05/2017**

Subject Name: Environmental Modeling

Time: 02:30 PM To 05:00 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)** Explain the terms (in context of lake modeling) **07**

(i) Detention time (ii) Effective mixing volume (iii) Chemocline (iv) Monomictic lake (v) Oligotrophic lake (vi) Benthic zone (vii) Littoral zone

(b) Enlist and explain types of environmental models along with examples. **07**

Q.2 **(a)** Derive the Streeter-Phelps equation for DO concentration considering Carbonaceous Biochemical Oxygen Demand and reaeration. Also write down the same equation considering nitrogeneous BOD also **07**

(b) Derive the mass balance equation for plug flow system. **07**

OR

(b) What are the physical, chemical and biological processes that control the fate of pollutants dispersed in to the environment? **07**

Q.3 **(a)** If a stream has a mean velocity of 0.4 m/s and concentration profile is given below from field measurements, estimate the in situ rate constant for BOD degradation: **07**

X,Km	0	5	10	20	30	50	100	200
C,mg/L	10	9.4	9.1	8.4	7.6	6.4	4.2	1.9

(b) Write a note on **07**

(i) Waste Load Allocation

(ii) River Segmentation

OR

Q.3 **(a)** A city discharges 94.8 MLD of domestic sewage into a stream whose typical rate of flow is 612 MLD. .The velocity of the stream is approximately 4.83Km/hr. The temperature of the sewage is 21°C, while that of the stream is 15°C. The 20°C BOD_5 of the sewage is 180mg/L, while that of the stream is 1.0 mg/L. The sewage contains no dissolved oxygen, but the stream is 90% saturated upstream of the discharge. At 20°C, kd is estimated to be 0.34 per day while kr is 0.65 per day. **07**

1. Determine the critical oxygen deficit and its location.
2. Also estimate the 20°C BOD_5 of a sample taken at the critical point. Use temperature coefficients of 1.135 for kd and 1.024 for kr.
3. Plot the dissolved oxygen sag curve.

The saturation value for O_2 at 15.7°C is 10.1mg/L.

(b) Enlist and explain the conventional pollutants in rivers. **07**

Q.4	**(a)**	Derive the equation for finding the pollutant concentration in the lake using continuous (step) input model.	**07**
	(b)	The following water quality parameters were measured for the average nutrient concentrations in the lake: NO_3 as N : 35µg/L PO_4 as P :0.6µg/L Assuming stoichiometric relationship for algal protoplasm, estimate the CO_2 uptake and rate of biomass production per day.	**07**

OR

Q.4	**(a)**	With the help of a neat sketch explain the elements in a mass balance using control volume concept.	**07**
Q.4	**(b)**	For a lake, there is a step input of phosphorus as given in the table below. Calculate the equilibrium concentration of phosphorus in lake and concentration after 0.01 year. Depth of lake =18.6 m Phosphorus Loading = 1.27g P/m^2.yr Detention time= 2.6 years k = 0.005/d Co = 25 µg/L Volume= 470Km^3	**07**

Q.5	**(a)**	Explain the chief features of following air quality models: (i) Box model (ii) Gaussian Plume Dispersion model	**07**
	(b)	Details about Aermod air quality model software. Enlist the data input required.	**07**

OR

Q.5	**(a)**	Enlist and explain the applications of environmental modeling.	**07**
	(b)	Explain the terms in context of models: (i) Calibration (ii) Verification (iii) Simulation (v) Validation (vi) Sensibility analysis (vii) Uncertainty analysis	**07**

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