MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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VI SEMESTER B.TECH. (BIOTECHNOLOGY / CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, APR 2018

SUBJECT: MICROBIAL TREATMENT OF WASTEWATER [BIO 4003]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

❖ Answer **ALL** the questions.
❖ Missing data may be suitable assumed.

1A.	Determine the mole fraction of oxygen in water if the concentration of dissolved oxygen is 10.0 mg/L	3
1B.	Determine the activity coefficients for the mono and divalent ions in the wastewater for the data given below. Using the value of the activity coefficient for a divalent ion, estimate the equilibrium concentration of calcium in solution needed to satisfy the solubility product for calcium carbonate ($CaCO_3$) at 25°C. The value of the solubility product constant K_{sp} at 25°C is 5×10^{-9}.	5

Cation	Concentration(ppm)	Anion	Concentration(ppm)
Ca^{2+}	82.2	HCO_3^-	220.0
Mg^{2+}	17.9	SO_4^{2-}	98.3
Na^+	46.4	Cl^-	78.0
K^+	15.5	NO_3^-	25.6

1C.	What are the adverse effects on the receiving water body when these pollutants are discharged in water along with effluents?	2
2A.	Illustrate the interrelationships of solids found in water and wastewater.	4
2B.	Determine the 1-day BOD and ultimate first-stage BOD for a wastewater whose 5-day 20°C BOD is 200 mg/L. The reaction constant k (base e) =0.23d-1. What would have been the 5-day BOD if the test had been conducted at 25°C?	4
2C.	Determine the ThOD for glycine ($CH_2(NH_2)COOH$) using the following assumptions, 1. the organic carbon and nitrogen are converted to CO_2 and NH_3, 2. NH3 is oxidized to nitrite and nitrate.	2
3A.	Determine theoretically the following for protein ($C_5H_7O_2N$) using Buswell equation	4

a) the gas composition (% carbon dioxide and % methane) when digesting protein

b) the volume of methane produced from 1 kg of protein(NTP)

3B. Explain the MPN analysis for the quantification of total coliform bacteria. 3

3C. The results of a coliform analysis using the multiple-tube fermentation test for the effluent from an intermitted sand filter are as given below. Using these data, determine the coliform density (MPN/100mL) using Thomas equation. 3

Size of portion, mL	1.0	0.1	0.01	0.001
Number of positive	4	3	2	0
Number of negative	1	2	3	5

4A. Determine the rise in temperature for the aerobic stabilization of raw sewage sludge, if the initial dry matter content is around 36 g/L (average organic dry matter content of sewage sludge) and the biodegradability of 50% within the residence time in the sludge reactor. 6

4B. Illustrate the steps involved in anaerobic degradation of cellulose 4

5A. Discuss in detail about the design considerations for Upflow anaerobic sludge blanket (UASB) process involving volumetric organic loading, upflow velocity, reactor volume, physical features and gas collection system. 6

5B. Explain the combined nitrification and denitrification process 4