M.E. (Civil, Environmental Engineering) 2nd semester Examination

Industrial Water Pollution Control **CE-1018**

Time: 3hrs. **Full Marks-70**

Answer any 5 (five) questions. All question carry equal marks.
Assume relevant data if necessary.

1. (a) Why equalization is necessary for industrial wastewater treatment facilities.
(b) A food processing industry produces wastewater of following characteristics. Show the mixing effect on BOD_5 loading due to installation of equalization basin before treatment facility of an activated sludge system assuming 24 hours treatment time. Also compare maximum BOD_5 to average BOD_5 ratio before and after mixing

Time interval, hr	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Flow rate(l/hr)	30	45	60	75	100	80	60	40
BOD_5 (mg/l)	100	150	200	300	300	250	200	150

(2+8+4=14)

2. (a) Why neutralization is necessary for treating industrial wastewater? At what ratio two wastes having pH = 3 and pH= 11 must be mixed to attain a neutral pH.
(b) An acidic wastewater of 0.1 (N) H2SO4 acidity is required to neutralize at pH 7.0 by limestone bed. Series of laboratory test by 30.5 cm diameter limestone bed for neutralization with the wastewater is presented in the following table. Calculate the most economical depth of lime stone bed and the amount of acid neutralized per month if wastewater generation rate is $10 m^3$/day

Column depth, m	0.5	1	1.5	2	2.5	3	4
Flow rate at pH7 (m^3/m^2/hr)	0.45	3	7	12	16	18	20

3.(a) What is coagulation and flocculation? (2+8+4=14)
(b) How stability of colloid material is attained? How it can be destabilized?
(c) Discuss briefly the settling column analysis in the laboratory of a Type-I suspension. Derive the final expression for percent solid removal from the same.

4. (a) What is solubility product constant? How common ion helps in precipitation? Give an example. (2+4+8=14)
(b) A zinc plating industry wants effluent Zn concentration below 0.01 mg/L by hydroxide precipitation. What pH it must be set to get effluent Zn below 0.01 mg/l. Assume K_{sp} of $Zn(OH)_2 = 5x10^{-17}$, MW of Zn= 65.41 g/mol.
(c) A source water has the following characteristics:
pH = 7.5 Alk = 100 mg/l as $CaCO_3$, Ca^{2+} = 380 mg/l as $CaCO_3$, Temp = 15°C, Mg^{2+}= 80 mg/l as $CaCO_3$ and I = 0.01 M Where I represents ionic strength of the water. Determine the chemical dose requirement for excess lime soda ash softening if the finished water is to contain 40 mg/l calcium and 10 mg/l magnesium (both as $CaCO_3$). Use Claudius-Lawrence diagram.

(2+4+8=14)

5. (a) Write the origin of waste, major characteristics and treatment of waste of the following Industries
(i) Pulp and paper industry (ii) Dairy products industry (iii) Tannery (iv) Fertilizer industry
(b) Mention the potential environmental problems from tannery waste?
(c) Describe briefly with neat sketch the operation carried out in tannery industry.

(4+4+6=14)

6. (a) What is ion exchange? Give an ion exchange reaction. Briefly discuss about different types of ion exchange materials in use.
(b) What are the selectivity sequence and the selectivity coefficient? Mention the factors that affect the selectivity coefficient.
(c) What is mass transfer zone (MTZ) and carbon usage rate (CUR)? Write the relationship between the MTZ and the critical depth of adsorption column.

(4+4+6=14)

(7) (a) Mention the assumptions in deriving Langmuir adsorption isotherm equation.
(b) Explain the terms: Adsorption; Absorption; and Sorption
(c) Batch experiments with powdered activated carbon (PAC) are conducted with a wastewater having initial pesticide concentration of 515mg/l. The equilibrium concentrations obtained after 12 hrs of experiment are tabulated in the following table. Find out the isotherm which the waste fits better. Also explain the physical significance of the isotherm constant. Liquid volume in each flask is 250ml.

Flask No	1	2	3	4	5	6	7	8
Concentration, mg/l	0.0582	0.0873	0.116	0.30	0.410	0.786	0.902	2.94
Dose, mg	1005	835	541	191	391	298	290	253

(2+3+9=14)