BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : VII**
BRANCH: CHEM. ENGG. / CEP&P **SESSION : MO/18**

SUBJECT: CL7031 POLUTION CONTROL EQUIPMENT DESIGN

TIME: 3:00 HRS. **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Explain the principle of coulometric analyzer with the help of neat schematic diagram? [6]

Q.1(b) What is the general arrangement of sampling system for stack sampling? And discuss about the "isokinetic" conditions for collection of particulate matter through the stack? [6]

Q.2(a) Show that the temperature lapse rate with altitude is -10°C/1 Km with the help of concept of air parcel (Assume that the atmosphere obeys perfect gas law)? Discuss about the stability of atmosphere? [8]

Q.2(b) Illustrate the different plume behaviors with the temperature rate? [4]

Q.3(a) A gas mixture contains 5% ammonia and 95% air (by volume) is to be scrubbed with water to reduce the ammonia content to 0.5%. The flow rate of the gas mixture entering the tower at the bottom at 25°C and 1 atm is 38.0 kg moles/hr while ammonia free water enters at the top of the tower at a rate of 47.4 kg moles/hr. The tower uses 1 in stoneware raschig rings packed at random and operates at 60% of the flooding point. The equilibrium data for ammonia-water system at 20°C and 1 atm as follows [12]

y_{NH3}	0.000	0.0158	00239	0.0328	0.0416
x_{NH3}	0.000	0.0208	0.0309	0.0405	0.0503

Calculate the scrubber diameter of the packed section that is necessary to satisfy the given conditions?

Q.4(a) If L_u is the ultimate BOD, L is the amount of BOD remaining in time t and k_1 is the deoxygenation constant per day, determine the equation for BOD utilization on day 5 (Y_5). And show the relationship between L, L_u and Y_5 on time vs BOD plot? [7]

Q.4(b) The following BOD results were observed for a sample of raw sewage at 20°C [5]

Time, Days	0	1	2	3	4	5
Y(BOD), mg/L	0	65	109	138	158	172

Calculate the reaction rate constant k_1' and the ultimate BOD L_u.

Q.5(a) What is growth curve of microbes? Make use of this curve to explain different phases involved in it? [4]

Q.5(b) A completely mixed activated sludge process is to be used to treat the wastewater flow of 500 m3/hr having a soluble BOD of 250 mg/L. The concentration of soluble BOD5 escaping treatment is 10 mg/L. Design criteria are as follows Y = 0.5, k = 5 /day, K_d = 0.06 /day. K_s = 100 mg/Land the concentration of microbes X = 2000 mg/L. compute the following a)the treatment efficiency, b)the mean cell residence time θc, c) the hydraulic retention time θ, d)the volume of the aeration tank, e) Food/Microorganism ratio? [8]

Q.6(a) Briefly discuss about the collection methods of solid waste. [2]

Q.6(b) Evaluate the various options for disposal of wastes and their selection criteria. [4]

Q.6(c) Explain the design, operation and maintenance of sanitary landfill. [6]

Q.7 Categorize the different unit operations operated and classify the different emissions, waste water, solid waste, hazard waste releasing and suggest the prevention and control methods of any one of the following industry. Fertilizer, paper and pulp, petroleum refinery and petrochemical, tanning, sugar, dairy and alcohol industries. [12]

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