M.E. (Civil) First Semester Examination Dec., 2011
Sub: Physicochemical Processes in Environmental Engineering (CE-914)

Full Marks: 70 **Time: 3 Hours**

Answer Question No. 10 and any six from the rest
Assume any relevant data if necessary.

1. With a neat sketch describe the stability of colloid. Describe different types of flocculation mechanism. Show that flocculation efficiency of same sized particles by differential settling is zero.

(3+3 +4)

2. Settling column analysis of a Type-I suspension is shown in the following table. Use the data to determine the percent removal of suspended solids in an ideal horizontal sedimentation basin operating at 2 $m^3/ m^2/$ hr. Samples are taken at 100 cm below the surface of the liquid in a batch sedimentation column. 'C' is the suspended solid concentration at time't' taken from the sampling port and C_0 is the initial solid concentration.

Time (min)	0	15	30	45	60	90	120
C/C_0 at 100 cm	1	0.95	0.80	0.75	0.66	0.50	0.20

(10)

3. (a) Describe how a settling column analysis can be carried out to evaluate suspension removal efficiency of flocculent nature.

(b) Iso-removal curves for a suspension of type-II is shown in Fig. 1. Calculate the solid removal efficiency of the sedimentation basin of depth 3 m. if the surface loading rate is 0.5 $m^3/m^2/hr$

(4+6)

4. Following data are obtained from the sieve analysis of a river sand to prepare a filter bed.

Sieve size (mm)	1.41	0.84	0.71	0.59	0.5	0.42	0.297	0.25	0.21	0.149
Cum.(%) retain	1	5	20	36	54	72	87	96	98	100

(a) Calculate the usable upper and lower sand size of the river sand if the filter has co-efficient of uniformity =1.75 and effective size = 0.4 mm

(b) How much river sand is required to prepare per kg of filter sand?

(6+4)

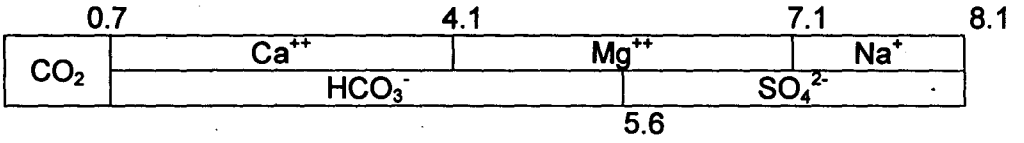
5. With a neat sketch describe the gas transfer mechanism into a liquid phase. Mention the factors on which gas transfer rate depends. Describe application of gas transfer in water and wastewater treatment.

(3+3+4)

6. (a) Draw a flow diagram of a two-stage softening with split treatment? How recarbonation may help to have a more effective removal of hardness?

(b) A water with the ionic characteristics shown below is to be softened by lime-soda-ash-excess-lime process to the minimum possible hardness. Calculate the chemical

requirements and draw the bar diagram of the finished water. Second-stage recarbonation is desirable.



The values are in meq/L

(3+7)

7. (a) Distinguish between strong-acid cation-exchange resin and weak-acid cation exchange resin.

(b) Removal of fluoride ions by activated alumina is explained as an ion-exchange process. Show the reactions for exchange and regeneration.

(c) Does the degree of cross-linkage have any effect on the exchange process by the resin?

(4+4+2)

8. (a) Explain how the nature of adsorbent may affect the adsorption process.

(b) What is adsorption isotherm? Mention one isotherm equation. How the isotherm may be used to select a suitable batch of activated carbon for practical application?

(c) How an activated carbon bed may be regenerated after its capacity is exhausted during treatment of wastewater?

(3+4+3)

9. (a) Compare chlorine disinfection with any non-chemical method of disinfection for drinking water treatment.

(b) Show a typical curve showing breakpoint chlorination. Explain the nature of the curve.

(c) Why the chlorine disinfection efficiency is dependent on pH?

(3+4+3)

10. Write short notes on (any four):

i) Coagulant aids, ii) Schmutzdecke, iii) Reverse osmosis, iv) Destabilization of colloids, v) Carbon utilization rate in adsorption, vi) Chromatographic peaking in multicomponent ion exchange

(10)

Fig1. Q.No.3(b)