

Department of Civil Engineering, IIT Delhi
CEL 212: Environmental Engineering (Second Semester 2013-14)
Minor 2 Exam-March 22nd 2014 (Total Points = 50; Duration = 60 minutes)

Note: Assume missing data (if any) and mention the same. Be precise in all open-ended questions.

Q1. Define following terms (<100 words): (i) role of depth in type 1 and Type 2 settling and (ii) ionic layer compression for negative charged particles and neutral charge particles. **[5+5=10 points]**

Q2. For a flocculant suspension (negatively charged), determine the removal efficiency of a 6 ft deep basin an overflow rate equals to 10 ft/h? **[10 points]**

Time, min	Percent suspended solids removed at indicated depth (In ft)					
	1.5	3.0	4.5	6.0	7.5	
20	61					
30	71	63	55			
40	81	72	63	61	57	
50	90	81	73	67	63	
60	—	90	80	74	68	
70	—	—	86	80	75	
80	—	—	—	86	81	

Q3. Following water is softened using the Lime-soda ash process (pH =9). Calculate amount of lime-soda ash required for treating 100 liters of water everyday? Write balanced equations for removing hardness of water using the Lime-soda process. **[10 points]**

Species	Concentrations (milli-equivalents/L)
Carbon dioxide	1.0
Ca ²⁺	4.0
Na ⁺	3.0
HCO ₃ ⁻	2.5
SO ₄ ²⁻	5.0

Q4. How does 100 mg/L alum perform in Vasant Kunj raw wastewater (pH5, 300 mg/L suspended solids, 150 mg/L alkalinity as CaCO₃) and in Yamuna river water (pH7, 100 mg/L suspended solids, 50 mg/L alkalinity as CaCO₃)? Explain using different coagulant mechanisms. It is given that 50mg/L alum is required to remove 90% of 300 mg/L suspended solids in Yamuna river water. **[10+10=20 points]**

+++++**Bonus question**+++++

Q41. A lake water (total volume=1000 m³) is polluted with 100 mg/L Al³⁺, 100mg/L Ca²⁺, alkalinity (100mg/L as CaCO₃), and 250 mg/L solids (50% particles are suspended solids). (at t=0). Further, the "AA" industry discharges an electronic industry wastewater (pH3) in this lake (50m³ volume). How does this discharge change the interaction of different species and solids present in lake for 4 hours of interaction? **[5 points]**