M.E. (Civil) 2nd Semester Final Examination, May 2014
Industrial Water Pollution Control (CE -1018)

Time: 3 hours **Full Marks: 100**

Assume any reasonable data if necessary.
Answer any five questions
Each question carries equal marks

1. (a) Define adsorption, absorption and sorption.
   (b) Distinguished between chemical adsorption and physical adsorption.
   (c) Explain different factors that influence adsorption.
   (d) Adsorption isotherm equilibrium study with 250 ml of sample for phenol removal at 25°C revels following data. The Initial concentration of phenol was 500 mg/L. Find the Langmuir isotherm constants and discuss whether the process is favorable or unfavorable.

Dose (mg/L)	10	50	90	150	200
Effluent Conc. (mg/L)	60	40	30	22	18

(3+3+4+10=20)

2. (a) What is activated carbon ?
   (b) State the different steps involved in the adsorption-desorption equilibrium process with a neat sketches.
   (c) What is the use of a breakthrough curve?
   (d) Give example of different types of ion-exchange materials. Mention typical exchange reaction and regeneration reaction for each type of ion-exchange material.

(2+7+4+7=**20**)

3. (a) Describe different chemical precipitation techniques available for removal of heavy metals from wastewater.
   (b) An electroplating industry is to treat its effluent chromium below 0.01 mg/L. At what pH should the wastewater be keep to achieve the effluent quality? Give a sketch of the unit operations of the process. MW of Cr = 51.996, K_{sp} of $Cr(OH)_3 = 6.3\times10^{-31}$.
   (c) Calculate the alkalinity and oxygen requirements for following dosages of coagulants (i) 10mg/L Alum (ii) 10 mg/L of Ferrous sulphate for chemical precipitation.

(6+ 6+ 8=**20**)

4. (a) What is colloid? With a neat sketch describe the colloidal stability. How can it be destabilized?
   (b) Describe briefly the laboratory settling column analysis to evaluate percent solid removal from dilute suspension of discrete particle. Give the final expression for percent solids removal.
   (c) Wastewater is flowing through a plain sedimentation basin of following dimensions: length 3m, width 2m and depth 1m. The wastewater flow rate is 12 m^3/hr. A settling column analysis is conducted with a 2.5m long column. The data are shown below. Calculate the theoretical removal efficiency of settlable particles if the particles follow type-I sedimentation.

Sampling Time (min)	0	10	30	45	60	90	120	150
Concentration, (mg/l)	600	250	200	150	110	80	50	30

(5 + 7+ 8 = **20**)

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5. (a) Mention the characteristics and available treatment processes of the following industrial wastewater: (i) Tannery (ii) Pulp and paper (iii) Electroplating (iv) Textile
(b) Mention the different processes of treating tannery wastewater? Describe vegetable tanning process in brief.
(c) Describe the water, air and land pollution impact of a tannery industry

(10+5+5=**20**)

6. (a) Define composite sample and grab sample
(b) At a wastewater monitoring station the following data were obtained.

Time interval(hr.)	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Flow rate (L/hr)	20	30	60	75	90	70	45	25
BOD(mg/L)	100	150	200	300	350	300	250	200

Calculate:
(i) The volume fraction to be collected from each time interval to prepare a 15 liter of composite sample.
(ii) The average concentration of the sample.

(4+8+8=**20**)

7. (a) What is equalization?
(b) Describe importance of equalization in treating industrial wastewater.
(c) Describe briefly how the volume of an equalization basin can be determined.
(d) Following data are obtained at a wastewater monitoring satiation. Compute the concentration of equalized BOD if the process operates through 24 hours time.

Time interval(hr.)	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Flow rate (L/hr)	15	30	50	80	90	70	40	20
BOD(mg/L)	100	150	200	300	350	300	200	100

(2 + 4 + 4 + 10 = 20)

8 (a) Mention importance of neutralization for treating industrial wastewater.
(b) An acidic waste of pH 4 is to be neutralized with a basic waste of pH 11. At what proportion should they must be mixed to get a final pH of 7?
(c) Laboratory tests are conducted to neutralize an acidic waste with 25 cm diameter limestone bed of different depths. The laboratory test results are shown in the following table. Calculate the optimum column depth if the wastewater flow rate is $1.5 m^3/m^2/hr$.

Depth, m	0.5	1.20	1.50	2.0	2.50
Hydraulic loading rate, $m^3/m^2/hr$	0.050	0.180	0.90	1.50	1.60

(d) Calculate also the weight of acid neutralized per day if the wastewater acidity is 0.025 (N) H_2SO_4.

(3+4+10+3=**20**)