B.E. (Civil) Part IV 8th Semester Final Examination, 2012-2013
Industrial Waste Treatment (CE 803/11)

Time: 3 hours **Full Marks: 70**

Use separate answerscript for each half.
Assume any reasonable data if necessary.

First Half

2 (Two) marks are reserved for neatness

*Answer any **THREE (3)** questions*

1. (a) Define adsorption isotherm. Write the expression for different types of adsorption isotherm.
   (b) Explain different factors that influence adsorption process.
   (c) A small industrial plant generates 100000 liters of wastewater per day. The wastewater contains 100 mg/l of phenol which must be reduced to 1 mg/l prior to discharge and an adsorption isotherm for this shows the adsorption capacity (x/m) to be 0.047 g/g for 1 mg/l effluent concentration using carbon as adsorbent. Assuming bulk density of carbon to be 385 kg/m^3, find the volume of carbon required.

(4+ 4+3=11)

2. (a) Discuss the reverse osmosis process with a neat sketch.
   (b) What is osmotic pressure? Find the osmotic pressure of a brine solution having 10000 mg/l of NaCl at 20^{O}C. Assume $\phi_c = 0.92$.
   (c) Discuss about different operational and design parameters of reverse osmosis process.

(3+3+5=11)

3. (a) State the Henry's Gas law. How does the air stripping of VOCs occur?
   (b) Discuss about the packed tower for air stripping of VOCs with a neat sketch.
   (c) Discuss about the wet air oxidation of industrial wastewater.

(4+4+3=11)

4. (a) Explain ion exchange process with example.
   (b) What is ion exchange resin? Give examples of different type of resins?
   (c) Compute the operating capacity of a cation exchange resin the experimental data is given below for the throughput volume of 1200 liter. The column was used to reduce Cr(3+) having initial concentration of 10 m-eq/liter. The volume of resin was 15 liter.

i=	1	2	3	4	5	6
V_i (liter)	500	100	200	100	200	100
Y_i	0.04	0.06	0.10	0.12	0.20	0.25

(3+4+4=11)

5. (a) Compare between industrial wastewater and municipal wastewater from its treatment perspective.
   (b) Explain 'BOD' and 'COD' with examples.
   (c) Draw the generalized flow diagram of industrial wastewater treatment plant. State the function of each unit process.

(3+3+5=11)

Second Half

Answer question no six (6) and any two from the rest
One mark reserved for neatness
Assume relevant data if necessary

6. Write short notes (Any three)
   a. pH and Alkalinity
   b. Composite sample and Grab sample
   c. Equalization and Neutralization
   d. Sedimentation and Chemical precipitation
   e. Coagulation and Flocculation

(3x4=12)

7. (a) Discuss the sources, characteristics and available treatment methods of the following industrial wastewater.
   (i) Dairy industry (ii) Paper and pulp industry (iv) Textile industry.

   (b) Describe briefly the effect of tannery waste on water, air and land pollution

(2x3+5=11)

8. (a) Show that sedimentation efficiency depends on plan area of a settling basin.
   (b) A settling column analysis is run on a wastewater with a 2m long column. The data are shown below. Calculate the theoretical removal efficiency of settlable particles if the grit chamber has length 3m, width 2m and depth1m. The wastewater flow rate is $15m^3$/hour.

Sampling Time (min)	0	10	30	60	90	120	180	240
Concentration, (mg/l)	300	150	100	75	60	45	35	30

(3+8=11)

9. At a wastewater monitoring station the following data were obtain.

Time interval(hr.)	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Flowrate(L/min)	30	45	50	75	80	70	65	60
BOD(mg/l)	100	150	200	250	300	250	200	150

Calculate:
(i) The volume fraction to be collected from each time interval to prepare a 5 liter of composite sample.
(ii) The average concentration of the sample.

(5+6=11)

10.(a) An electroplating industry waste (pH=3.5) require neutralization before chemical precipitation to treat its wate before discharge. Series of laboratory column study with 0.3048m diameter column to attain neutral pH revels following result. Calculate the most economic depth of the bed.

Column depth, m	0.5	1	1.5	2.0	2.5	3.0	3.5
Hydraulic loading ($m^3/m^2/hr$)	1	3	6	10	14	18	20

(b) At what ratio two wastes of pH = 3 and pH =10 must be mixed to attain a neutral pH.

(7+4=11)