B.TECH. SEM -VI (CHEMICAL 2014 COURSE (CBCS) :
SUMMER - 2018
SUBJECT: SEPARATION TECHNIQUES

Day: **Friday** Time: **02.30 PM TO 05.30 PM**
Date: **01/06/2018** **S-2018-2385** Max. Marks: 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Draw neat and labelled diagrams **WHEREVER** necessary.
4) Assume suitable data if necessary.

Q.1 **a)** What is importance of relative volatility in distillation? Derive the expression **(05)**

$$y = \frac{\alpha x}{1+(\alpha-1)x}$$

b) Derive the Rayleigh's equation for simple distillation. **(05)**

OR

Q.1 A simple batch still is used to distill 1000 kg of a mixture containing 60 mass % ethyl alcohol and 40 mass % water. After distillation, the bottom product contains 5 mass % alcohol. Determine the composition of overhead product its mass and mass of bottom product. The equilibrium data: **(10)**

x	5	10	20	30	40	50	60
y	36	51.6	65.5	71	74	76.7	78.9

Where x and y are wt % of ethyl alcohol in liquid phase and vapour phase respectively.

Q.2 What are the assumptions of McCabe Thiele method? **(10)**
Derive the material balance or operating line equations for enriching and exhausting sections of rectification column.

OR

Q.2 A continuous fractionating column, operating at atm. pressure, is be designed to separate a mixture containing 15.67 % CS_2 and 84.33 % CCl_4 into an overhead product containing 91% CS_2 and a waste of 97.3 % CCl_4 (all mass %). Assume a plate efficiency of 70% and a reflux of 3.16 kmole/ kmole of product. Using data below, determine the no. of plates required. . Feed enters at 290 K with a specific heat of 1.7 kJ/kg K and a boiling point of 336 K. Latent heat of CS_2 and CCl_4 is 25,900 kJ/ kmole. **(10)**

X	0	2.96	6.15	11.06	14.35	25.85	39.00	53.18	66.3	75.75	86.04
Y	0	8.23	15.55	26.6	33.2	49.5	63.4	74.7	82.9	87.8	93.2

Q.3 A solid adsorbent is used to remove color impurity from an aqueous solution. The original value of color on an arbitrary scale is 48. It is desired to reduce this to 10% of its original value. Using the following data, find the quantity of fresh adsorbent used for 1000 kg solution for: **(10)**

i) Single stage
ii) Two state crosscurrent operation when intermediate color value is 24.

$X \frac{\text{kg of colour}}{\text{kg of adsorbent}}$	0	5000	4125		3312	1975	1112
$Y \frac{\text{kg of colour}}{\text{kg of solution}}$	48	43	31.5		21.5	8.5	3.5

OR

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Q.3 Draw a schematic diagram of multistage countercurrent adsorption and write the material balances. Also show the graphical representation of multistage countercurrent adsorption. **(10)**

Q.4 If 1000 kg/hr of nicotine (C) water (A) solution containing 1.5 % nicotine is to be counter currently extracted with kerosene at 20^0 to reduce the nicotine content to 0.5 %. Determine : **(10)**
i) Minimum kerosene rate
ii) No. of theoretical stages required if 1000 kg of kerosene is sued per hr.

x'	0.0011	0.00246	0.00502	0.00751	0.00998	0.0204
y'	0.000807	0.001961	0.00456	0.00686	0.00913	0.0187

OR

Q.4 100 of a solution containing acetic acid and water containing 25% acid by weight is to be extracted with isopropyl ether at 20^0C. The total solvent used for extraction is 100 kg. Determine the compositions and the quantities of various streams if the extraction is carried out in two stages with 50 kg of solvent in each stage. **(10)**

Water layer (wt %)		Ether layer (wt %)	
Acid (C)	Ether (B)	Acid (C)	Ether (B)
0.69	1.21	0.18	99.32
1.41	1.44	0.37	98.93
2.9	1.6	0.79	98.4
6.42	1.88	1.93	97.04
13.3	2.3	4.82	93.28
25.5	3.4	11.4	84.7
36.7	4.4	21.6	71.5
44.3	10.6	31.1	58.1
46.4	16.5	36.2	48.7

Q.5 Discuss the typical solid-liquid equilibrium diagrams usually encountered in practice. Also explain the graphical representation of concentration is leaching process. **(10)**

OR

Q.5 Draw flow diagram of multistage crosscurrent leaching and explain the graphical representation. Also state the material balance equations. **(10)**

Q.6 **a)** How supercritical fluid extraction can be used for reactive separations of compounds. **(05)**

b) What is the importance of zone melting in Reactive separations? **(05)**

OR

Q.6 **a)** Differentiate between reverse osmosis and nano-filtration with specific applications **(05)**

b) Explain the process of reactive distillation with suitable example. **(05)**

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