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No. Of Printed Pages 03

SARDAR PATEL UNIVERSITY
EXTERNAL EXAMINATION, OCTOBER 2016
M.Sc. INDUSTRIAL CHEMISTRY-SEM 1
MASS TRANSFER OPERATIONS - PS01CICH09

25th October, 2016

Max.Marks:70

Time:10.00 a.m -1.00 p.m

Answer all the questions.

Figures to the right side indicate marks

Q1. Write the number of the correct answer. (each question carries one mark) (08)

- a. Heat sensitive liquid materials with very high latent heat of vaporization may be economically separated using
i.Liquid extraction ii. Evaporation iii.Distillation iv. Absorption
- b. The solvent rich product of liquid extraction is called as
i. Feed ii. Raffinate iii.Extract iv. Solvent
- c. For separating a high boiling mixture where decomposition of material is to be avoided, we use
i. Simple distillation iii.Steam distillation
ii. Azeotropic distillation iv. Flash distillation
- d. Gas-liquid contact in a sieve plate column is -----than that in bubblecap column
i. Less than ii. More than iii.Equal to iv. Double than
- e. Detergent solutions is dried to powder in a --- drier.
i. Freeze ii.Spray iii.Tray iv.Rotary
- f. The rate of drying in a cross circulation drier is directly proportional to-----.
i. gas temperature iii.thickness of solid to be dried
ii. moisture content of solid to be dried iv.thickness of tray
- g. Operating velocity in packed columns should be 50% of -----.
i. flooding velocity iii.critical velocity
ii. fluidization velocity iv.none of the above
- h. Which packing gives better liq-vapour contact ?
i. Rasching ring ii.Intalox saddles iii.Sodium balls iv.Ethanol

Q2. Answer any seven (7 * 2 =14 marks)

- a. Enlist the variables affecting rate of filtration
b. What are the points to be considered in the selection of solvent for Gas absorption?
c. Distinguish between constant rate and constant pressure filtration.
d. Compare liquid liquid extraction with distillation
e. What are the points to be considered in the selection of solvent for extraction?
f. Distinguish between cross current and counter current extraction .
g. Distinguish between cross circulation and through circulation drying
h. What are the variables affecting rate of drying in a cross circulation drier
i. What is the need of optimum reflux ratio in distillation ?

Q3.

- a. 5000 kg/hr of Acetone –water mixture with 40 % acetone ($h_F = 70$ Kcal/kg) is to be rectified using continuous distillation to get a distillate with 98 % acetone (enthalpy of distillate = 50 kcal/kg) and a residue with 3 % acetone (enthalpy of residue = 320 Kcal/kg). Find the minimum reflux ratio required and the corresponding condenser and reboiler duty. **(06)**

Mole fraction	0	0.2	0.4	0.6	0.8	0.9	10
Enthalpy (liquid) kcal/kg	345	185	70	11	22	40	65
Enthalpy (vapour) kcal/kg	1200	1100	1000	890	770	700	554
x	0	0.2	0.4	0.6	0.8	0.9	1
y	0	0.78	0.96	0.99	0.998	0.999	1

- b. Derive the operating equation for enriching and stripping sections of a fractionator using Ponchon-Savarit method **(06)**

OR

- b. With the help of examples, distinguish between extractive & azeotropic distillation **(06)**

Q4.

- a. Define channeling and flooding in packed column gas absorption. Why is controlling L/G ratio important in gas absorption? **(06)**

- b. With the help of a neat figure, explain the working of packed column gas absorber **(06)**

OR

- b. With the help of neat figures, describe the various industrially used packings **(06)**

Q5.

- a. With the help of a neat figure, explain the principle and working of RDC **(06)**
 b. Find the number of stages required to treat component C using cross current liquid liquid extraction as per the details given below. **(06)**

Feed = 1000 kg/hr, Solvent = 300 kg/hr, $X_F = 40\%$, $X_n = 1\%$					
Extract			Raffinate		
A	B	C	A	B	C
1	85	14	88	2	10
3	73	24	77	3	20
7	59	34	65	5	30
11	50	39	58	7	35
15	42	43	51	9	40
25	29	46	45	12	43

OR

b. 3000 kg of pyridine-water solution with 40 % pyridine is to be cross currently extracted using 2000 kg of Chlorobenzene in each stage to reduce pyridine concentration to 2 % in the final raffinate. Determine the number of theoretical stages. (06)

Extract			Raffinate		
C	B	A	C	B	A
0	99.95	0.05	0	0.08	99.92
11	88	1	5	0.16	94.84
24	74	2	19	0.38	80.62
32	65	3	36	2	62
41	52	7	53	9	38
49	38	13	49	38	13

Q6

a. The result of batch drying test conducted on a wet sample using a tray drier of area 1 m² is given below. Calculate the critical values of drying rate and moisture content. (06)

Wt(kg)	24.923	24.7959	24.67	24.5454	24.495	24.446	24.397	24.348	24.324	24.3	24.3
Time (min)	0	5	10	15	20	25	30	35	40	45	50

b. Prove that the flow rate through a spillway(Q) is given by the relation

$Q = VD^2 \phi(Dg/V^2, H/D)$ where V= average velocity, D= depth at throat, H= Head of water, g= Acceleration due to gravity. Use V & D as repeating variables (06)

OR

b. If the heat transfer co-efficient h for a liquid flowing through a pipeline depends on the dia of pipe D, velocity at which it flows U, its density (ρ), viscosity (μ), heat capacity (Cp) and thermal conductivity (k), prove using Rayleighs equation that $h = \phi(N_{RE}, N_{Pr})$ where N_{RE} is the Reynolds number and N_{Pr} is the Prandtl number (06)

*****Best of luck*****

