

Seat No.: \_\_\_\_\_

Enrolment No. \_\_\_\_\_

## GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – II<sup>nd</sup> - Examination – June/July- 2011

Subject code: 1723001

Subject Name: Advance Mass Transfer

Date: 22/06/2011

Time: 10:30 am – 01:00 pm

Total Marks: 70

### Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

**Q.1** Find the mole fraction of n-butane in distillation and also in residue by Thiele Geddes method based on following method. **14**

1. Feed Composition

Component	mole%
n-butane	37
i-pentane	32
n-pentane	21
n-hexane	10

n-butane is light key component and i-pentane is heavy key component

2. feed flow rate  $F = 4750$  mol/hr feed is saturated liquid at its bubble point
3. reflux ratio  $R = 3$
4. distillate flowrate  $D = 1250$  mol/hr
5. Residue flowrate  $W = 3500$  mol/hr
6. operating pressure = 2 atm (abs)
7. assume constant molal overflow. Total condenser is used
8. equilibrium constant values of n-butane are as follows

Tray numbers	Temperature $^{\circ}\text{C}$	K
1	22	1.086
2	24	1.156
3	28	1.308
4 = feed	32	1.474
5	41	1.904
Reboiler	48	2.300

**Q.2** (a) Write note on Ultra filtration. **07**  
(b) Discuss various types of membrane module in detail. **07**

**OR**

(b) Discuss the Equation Tearing Procedure for multi component Distillation. **07**

**Q.3** A saturated liquid consisting of chloro methane is fractionated to give a top product of 99.94 % (by mole) methyl chloride. Methyl chloride is light key component and methylene chloride is heavy key component. Total condenser is used. Composition of feed, distillate and residue are given. Average relative volatilities of all components are also given. Feed flow rate is 100 kmol/hr. Calculate the minimum reflux ratio by Underwood's method. **14**

Component	$\alpha_{av}$	Feed Mole %	Distillate Mole %	Residue Mole %
Methyl chloride	5.9163	73.7	99.94	0.94
Methylene chloride	1	20.4	0.06	76.89
Chloform	0.502	4.7	--	17.62
Carbon tetrachloride	0.32	1.2	--	4.55

Where  $\alpha_{av}$  = Average relative volatility of component with respect to heavy component

**OR**

**Q.3** Write advantages and disadvantages of superheated steam dryer over hot air dryer. **14**

**Q.4** Chlorine is to be scrubbed by 15% NaOH solution (by mass) in packed tower type absorber. Following data are available. **14**

1. feed flowrate = 80 kg/hr of chlorine plus 320 kg/hr of air. Air is added for dilution.
2. feed gas temperature and pressure = 40<sup>0</sup> C and atmosphere
3. solvent : 15% NaOH solution , density of solution = 1100 kg/m<sup>3</sup>  
viscosity of 15% NaOH solution = 5 cp
4. temperature of solution = 15 to 20<sup>0</sup> C
5. packing material : 25 mm polypropylene pall ring packing factor  $F_p = 170 \text{ m}^{-1}$
6. Reaction  $2\text{NaOH} + \text{Cl}_2 \rightarrow \text{NaOCl} + \text{NaCl} + \text{H}_2\text{O}$
7. heat of reaction  $\Delta H_R = -24.65 \text{ kcal/mol}$
8. mass transfer coefficient for the absorption of chlorine in 15% NaOH solution  $K_{Ga} = 100 \text{ kmol/m}^3\text{h}$

Determine the following

- a. actual amount of solvent required or circulation rate of NaOH solution required
- b. Tower Diameter (use fig 1)
- c. Height of packing required
- d. Heat duty of chilled water cooler required

**OR**

**Q.4** Discuss the Stepwise procedure for the process design of multi component batch distillation with rectification. **14**

**Q.5 (a)** With neat Sketch explain the working of Falling film absorber. Discuss about its advantages and disadvantages over packed type adiabatic absorber. **07**

**(b)** Discuss the criteria for Spray tower, Venturi scrubber and Tray tower as absorbers. **07**

**OR**

**Q.5 (a)** Write a note on osmotic distillation. **07**

**(b)** Describe the advantages and disadvantages of microfiltration. **07**

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