Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. - SEMESTER – VIII EXAMINATION – OCTOBER 2012

Subject code: 180505 Date: 25/10/2012

Subject Name: Multi Component Distillation

Time: 02.30pm - 05.00pm Total Marks: 70

Instructions:

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

Q.1 **(a)** Define following: **07**

1) Light key component
2) Heavy key component
3) Adjacent key
4) Split key
5) Distributed component
6) Non distributed component
7) Optimum reflux ratio

(b) What is Vacuum distillation? Discuss the advantages and disadvantages of Vacuum Distillation. **07**

Q.2 **(a)** Discuss the criteria for selection of solvent for extractive distillation. **07**

(b) Discuss FUG method to determine theoretical stages for multicomponent distillation. **07**

OR

(b) Isopropyl Alcohol (IPA) forms a minimum boiling azeotrope with water at 80.4^0C and 101.325 kPa, having composition of 31.47 mole% water. A feed consisting of 23 mole%. IPA under saturated liquid conditions is to be distilled to give 67.5 mole% IPA as distillate and 0.1 mole% IPA in bottoms. Find the number of theoretical stages required for the separation at 1 atm. Reflux ratio is 3. VLE data for IPA-water at 1 atm are as follows: **07**

x	0	0.02	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.6853	0.8	0.9	1
y*	0	0.25	0.4	0.49	0.537	0.55	0.57	0.6	0.64	0.6853	0.77	0.87	1

Q.3 A saturated liquid, consisting of phenol and cresols with some xylenols, is fractioned to give a top product of 95.3 mole % phenol. Metacresol is heavy key and phenol is light key component. Total condenser is used. The compositions of the top product and of the phenols in the bottoms are given. **14**

Component	Average Relative Volatility	Feed, mole %	Top product, mole %	Bottom product, mole %
Phenol	1.98	35	95.3	5.24
o-Cresol	1.59	15	4.55	?
m-Cresol	1.00	30	0.15	?
Xylenols	0.59	20	-	?

(1) Compute the material balance over the still for a feed rate of 100 kmol/h.

(2) Calculate the minimum reflux ratio by Underwood's method.

OR

Q.3 **(a)** Discuss concept and working principle of azeotropic distillation with industrial example. **07**

(b) Discuss criteria for selection between tray tower and packed tower with industrial examples. **07**

Q.4 200 kmol/h of feed, containing 50% benzene, 25% toluene and 25% o-xylene, is to be separated in batch distillation with a rectification column. Top product must contain 99% benzene. All compositions are mole%. Composition of distillate should remain constant throughout the batch distillation. Distillation is to be continued until the moles of benzene are reduced to 10 kmol in residue. Average relative volatility for benzene, toluene and o-xylene is 2.497,1 and 0.3459 respectively. Determine the Reflux ratio Vs. Time data. **14**

OR

Q.4 A distillation column is to separate 4750 mol/h of feed composed of 37% n-butane, 32% iso-pentane, 21% n-pentane and 10% n-hexane. The column operates at an average pressure of 2 atm a and will produce a distillate product containing 95% n-butane and 5% iso- pentane. The bottom product is allowed to contain no more than 570 mol/h of n-butane. If minimum reflux ratio is 1.45, then determine number of theoretical stages required for separation. **14**

Q.5 A fatty acid mixture contains palmitic acid, steric acid and oleic acid. Compositions for feed, distillate and residue is given as follows: **14**

Component	Feed Mole%	Distillate Mole%	Residue Mole%	Average Relative Volatility
Palmitic acid	11.94	99	1	1.9089
Steric acid	3.91	0	4	0.7654
Oleic acid	84.15	1	95	1

Molar flow rates of distillate and residue are 3.2 kmol/ h and 0.4 kmol/ h respectively. If minimum reflux ratio is 9, then find the number of theoretical stages required for desired separation. Also, determine feed tray location.

OR

Q.5 **(a)** Discuss the criteria of selection among various types of plates. **07**

(b) Discuss Thermally Coupled Distillation. **07**

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