Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII EXAMINATION – WINTER 2015

Subject Code:180505 Date:12/12/2015

Subject Name: Multi Component Distillation

Time: 2:30pm to 5:00pm Total Marks: 70

Instructions:

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

Q.1 **(a)** Explain how operating pressure of distillation column is determined. **07**

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

Q.2 **(a)** Discuss FUG method to determine theoretical stages for multicomponent distillation. **07**

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

OR

(b) State the steps for Theile Geddes method for calculation of theoretical stages in stripping section. **07**

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 the criteria for selection of solvent for extractive distillation. **07**

(b) State the algorithm or steps for Lewis Matheson method to calculate theoretical stages in rectification section & also state feed tray identification. **07**

Q.4 Determine the minimum reflux ratio for the binary distillation at standard atmospheric pressure based on the following data. **14**

Feed = 100 kmol/h
Feed mixture: benzene – toluene
Mole fraction of benzene in feed = 0.4
Condition of feed = at 30 ^{0}C
Mole fraction of benzene in distillate required = 0.99
Mole fraction of benzene in residue required = 0.02
Average relative volatility = 2.25
ln p_{vB} = 15.9008 – 2788.51/(T–52.36) for benzene in torr
ln p_{vT} = 16.0137 – 3096.52/(T–53.67) for toluene in torr
Normal boiling point of benzene = 80.1 ^{0}C
Normal boiling point of toluene = 110.6 ^{0}C

Property data of benzene & toluene

Component	C_L at 62.65 ^{0}C, kJ/(kmol.^{0}C)	λ at 95.3 ^{0}C, kJ/kmol
Benzene	146.96	29391.3
Toluene	173.33	34666.7

OR

Q.4 **(a)** Explain the method of determining tower diameter in sieve tray tower. **07**

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

Q.5 200 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.5 **(a)** Explain the concept of heat integration in distillation column. **07**

(b) List out the various design options for energy conservation in distillation column. Also discuss the energy saving in distillation column by direct vapour compressor. **07**

****