Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER–VIII • Remedial EXAMINATION – WINTER 2013

Subject Code: 180505   **Date: 12/09/2013**
Subject Name: Multi Component Distillation
Time: 03:00 pm – 05:30 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 **(a)** In the production of chloromethanes, a saturated liquid mixture **14** consisting of 60% methyl chloride(CH_3Cl), 28% methylene chloride(CH_2Cl_2), 9% chloroform($CHCl_3$) and 3% carbon tetra chloride(CCl_4)(by mass), is sent to distillation for separation of pure products. In first distillation column 99.9% (by mass) pure methyl chloride is separated as top product and 738 kmol/h pure methyl chloride is present in distillate. Feed is saturated liquid mixture and flow rate is 1000 kmol/h.

Component	Average Relative Volatility
Methyl chloride	6.224
Methylene chloride	1
Chloroform	0.4954
Carbon tetra chloride	0.3126

    Determine the following of distillation column:
    (a) Do the complete material balance.
    (b) Minimum reflux ratio by Underwood's method
    (c) If R= 3R$_m$, calculate the number of theoretical stages required for desired separation.

Q.2 **(a)** Discuss various factors that must be considered for the selection of tray **07** type in tray tower.
    (b) (i) What is MESH equation? In multicomponent distillation, for C **04** components and N number of equilibrium stages how many MESH equations can be written?
    (ii) What are the disadvantages of vacuum distillation? **03**
<div align="center">OR</div>
    (b) Discuss in detail about selection of operating pressure for distillation **07** column.

Q.3 **(a)** List out the variables that are to be specified as input data for Thiele- **10** Geddes method. Explain the stepwise procedure of Thiele Geddes method for stripping section of Multicomponent distillation.
    (b) How will you identify feed tray location in Lewis –Matheson method of **04** Multicomponent distillation?
<div align="center">OR</div>
Q.3 **(a)** Explain the method of determining tower diameter in sieve tray tower. **07**
    (b) Discuss heuristics for determining favorable sequences in distillation **07** column.

Q.4 **(a)** A saturated liquid, consisting of phenol and cresols with some xylenols, **14** 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.

Component	AverageRelative 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	-	?

(a) Compute the material balance over the still for a feed rate of 100 kmol/h.
(b) If $R=3R_m$, calculate the composition of vapour entering to the top most tray by Lewis –Matheson method. Assume $R_m= 1.67$.

OR

Q.4 **(a)** Explain the step wise procedure for the process design of **12** multicomponent batch distillation with rectification.
(b) Write down Hegstebeck and Geddes equation for approximate **02** distribution of non key components in top product and bottom product.

Q.5 **(a)** List out the various design options for energy conservation in distillation **09** column. Also discuss the energy saving in distillation column by direct vapour compressor.
(b) Discuss selection criteria of solvent for successful extractive distillation **05** sequence.

OR

Q.5 **(a)** Explain concept and working principle of azeotropic distillation with **09** industrial example.
(b) Explain the concept of heat integration in distillation column. **05**

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