Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII (OLD) - EXAMINATION – SUMMER 2017

Subject Code:180505 **Date:06/05/2017**

Subject Name: Multi Component Distillation (Department Elective-II)

Time:10:30 AM to 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 (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) Discuss about heat integration & optimum design of distillation column. **07**

Q.2 (a) Discuss the selection criteria of operating pressure for distillation column. **07**

(b) Discuss Sequencing of multi component distillation columns with example. **07**

OR

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

Q.3 (a) Determine the minimum reflux ratio for the binary distillation at standard atmospheric pressure based on the following data. **10**

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

(b) Define: Jet flooding, Down comer flooding, Liquid entrainment, Weeping. **04**

OR

Q.3 (a) Discuss FUG method to determine theoretical stages for multicomponent distillation. **07**

(b) Discuss the use of heat pump with auxiliary heat transfer medium for saving the energy consumption of distillation column. **07**

Q.4 Find the disribution (or mol/h) of *n*-Butane in distillate and in residue by Thiele – Geddes method based on the following data. **14**

Table : Feed Composition
(i) Component mole %
n–Butane 37
i–Pentane 32
n–Pentane 21
n–Hexane 10
n–Butane is light key component and *i*– Pentane is heay key component.
(ii) Feed flow rate F = 4750 mol/h. Feed is saturated liquivd at its bubble point.
(iii) Reflux ratio, R = 3
(iv) D = 1250 mol/h, W = 3500 mol/h
(v) Operating pressure, p = 2 atm a
(vi) Assume constant molal overflow. Total condenser is used.
Equilibrium Constants Data for n-Butane

Tray number	**Temperature, ºC**	**KC_4**
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

OR

Q.4 Discuss the step wise procedure for the process design of multicomponent batch distillation with rectification. **14**

Q.5 (a) Discuss the criteria of selection among various types of trays. **07**
(b) Discuss the advantages and disadvantages of extractive distillation over azeotropic distillation. **07**

OR

Q.5 (a) Explain the method of determining tower diameter in sieve tray tower. **07**
(b) Explain azeotropic distillation with industrial example **07**

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