

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – III • EXAMINATION – WINTER • 2013****Subject code: 731602****Date: 28-11-2013****Subject Name: Computer Aided Product and Process Design****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** (a) Discuss Heuristics for designing separation processes. **04**
 (b) Explain superstructure with modeling for reactor network synthesis with specific example of your choice. **10**

- Q.2** (a) Discuss the criteria of selection of spray tower and falling film absorber as absorber. **07**
 (b) Explain the step-by-step process of selecting best sequence for ternary feed mixture based on minimum vapor rates. **07**

OR

- (b) Consider a plant consisting of three stages that manufactures two products, A and B. The demands are 600,000 kg/year for A and 300,000 kg/year of B, and the production time considered is 6000 hours. Data for processing time and size factors are as follows: **07**

	Processing time (hr.)			Size Factors (m ³ /kg prod)		
	Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3
A	4	2	3	2	5	3
B	3	2	5	1.5	6	2

Assume that both the products have same batch size

Determine the size of vessels of a multi-product batch plant if the production cycle is of 500 hrs consisting of two campaigns: one for A and one for B. Only one vessel is to be used in each stage.

- Q.3** (a) Explain Geometrical concept for Attainable Regions for van de Vusse reaction. **07**
 (b) You are to separate the following relatively ideally behaving mixture of A, B, and C. The feed is at its bubble point of 345.8 K at 1 bar. The Underwood roots for the original feed are 1.116 and 2.826. The minimum vapor flow of the columns are as under: **07**

$$V_{\min}(A/BC) = 828 \text{ kmol/hr}$$

$$V_{\min}(AB/C) = 254 \text{ kmol/hr}$$

$$V_{\min}(A/B) = 830 \text{ kmol/hr}$$

$$V_{\min}(B/C) = 183 \text{ kmol/hr}$$

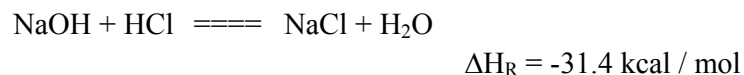
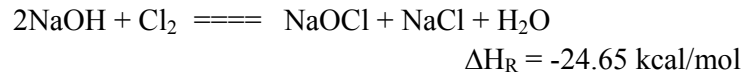
- Which sequence is to be preferred? Why?
- Explain the method of calculating marginal vapor flows. (Very approximate method.)

OR

- Q.3 (a)** Write a generalized MILP model for synthesizing distillation sequences for any mixture of n components that is to be separated into pure components. **07**
- (b)** For the objective to minimize the investment cost given fixed product demand write MINLP design model for flow shop plants - single product campaigns. **07**

Q.4 Packed tower type scrubber is required for the following duty. **14**

- (i) Feed gas : 15 kg/h HCl + 15 kg/h Cl₂ + 600 kg/h air
- (ii) Solvent : 10% NaOH solution
- (iii) Concentration of HCl and Cl₂ in exit gas: 20 mg/m³.
- (iv) Chemical Reactions :



Calculate :

- (a) Amount of solvent required. Tower diameter required for this scrubber is 0.36m. Specific heat of recirculating solvent is 0.9 kcal/ (kg.K). Poly propylene pall rings are selected as packing material for which value of MWR is 4 m³/ (h.m²).
- (b) Calculate the number of overall gas phase transfer unit.
- (c) Calculate the height of packing required. Mass transfer coefficient, $K_{Ga}=272 \text{ kmol}/(\text{m}^3.\text{h})$

OR

- Q.4 (a)** Explain the following. **14**
- (a) Equation-Tearing Procedure using Tridiagonal matrix algorithm for multicomponent distillation.
 - (b) Calculation of shell side heat transfer coefficient by Bell's method.

Q.5 (a) Discuss the advantages and disadvantages of vacuum distillation over atmospheric distillation. **07**

(b) Discuss Tinker's Flow Model and significance of sealing strips. **07**

OR

Q.5 Discuss Lewis-Matheson method for multicomponent distillation. Also explain about how to start the second trial calculation and arrive on final solution. **14**
