

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – WINTER 2013****Subject Code: 160505****Date: 04-12-2013****Subject Name: Computer Aided Process Synthesis****Time: 02:30 pm to 05:00 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) “Design problems are open ended and may have many solutions that are alternative and near optimal” Justify the statement. **05**

(b) List out and briefly explain any three environmental factors in process design. **05**

(c) Briefly explain ‘reactor network synthesis’ **04**

Q.2 (a) Explain the terms Minimum approach temperature, Optimum approach temperature and Threshold approach temperature for HENS. **06**

(b) Explain the step by step procedure to estimate the optimum value of ΔT . **08**

OR

(b) For the Heat Exchanger Network Synthesis (HENS) problem following stream information is available: **08**

Stream	$t_{in}^{\circ C}$	$t_{out}^{\circ C}$	FC_p kW/ $^{\circ}C$
C1	60	180	3
C2	30	100	2
H1	180	40	2
H2	150	40	4

Draw HCC and find out pinch point for $\Delta T_{min} = 10^{\circ}C$.

Q.3 (a) Two cold streams, C1 and C2 are to be heated and two hot streams H1 and H2 are to be cooled without phase change. Their conditions and properties are as follows: **07**

Stream	$t_{in} (^{\circ}C)$	$t_{out} (^{\circ}C)$	FC_p (kW/ $^{\circ}C$)
H1	260	160	3
H2	200	100	1.5
C1	120	235	2
C2	180	300	3

Calculate the smallest possible amounts of heating and cooling utilities for the above network. Use $\Delta T_{min} = 20^{\circ}C$.

(b) For the Heat Exchanger Network Synthesis (HENS) problem using the information in question 3(a) write a model for minimum utility cost if H1 and C2 are not allowed to exchange heat. **07**

OR

Q.3 (a) Explain: How inter-cooling, inter-heating and preheating of feed increases possibility of energy integration in distillation? **05**

(b) What is stream splitting? Explain how stream splitting can help in getting better design alternatives. **05**

(c) Discuss the effect of minimum temperature driving force, ΔT_m for design of heat exchanger network. **04**

- Q.4 (a)** Explain multi effect distillation **05**
(b) Discuss heuristics for selection of separation method **05**
(c) Explain Separation Sequencing for Solid-Fluid Systems **04**

OR

- Q.4 (a)** Explain Geometrical concept for Attainable Regions for van de Vusse Reaction. **07**
(b) We have a mixture of five alcohols labeled as A, B, C, D and E with flows in the feed of 1, 0.5, 1, 7 and 10 mol/s respectively, for a total of 19.5 mol/s and relative volatilities are 4.3, 4, 3, 2, and 1 respectively. The information about marginal vapor flows estimated for nonkey species are as under: **07**

	A	B	C	D	E
A/B	--	--	2.6	6.5	3.2
B/C	5.3	--	--	9.3	4.0
C/D	2.4	1.3	--	--	6.7
D/E	1.5	0.8	2.0	--	--

Find the best distillation based separation sequence.

- Q.5 (a)** Explain Marginal vapour flows and its importance in deciding sequence of distillation columns. **06**
(b) Given the processing times for two products A and B, determine makespan and cycle time for manufacturing one batch of A and one of B using (a) Zero wait policy (b) No intermediate storage policy (c) Unlimited intermediate storage policy. **08**

	Processing Times(hr)		
	Stage 1	Stage 2	Stage 3
A	6	4	3
B	3	2	2

OR

- Q.5 (a)** Plot Gant chart and discuss parallel units and intermediate storage policy effect on design and scheduling of batch plant discussing the example of fermentation separation system. **06**
(b) Consider a plant consisting of two stages that manufactures two products, A and B. The demands are 500,000 kg/year for A and 300,000 kg/year of B, and the production time considered is 6000 hours. Data for processing time, size factors and cleanup times are as follows: **08**

	Processing time (hr.)		Size Factors (m ³ /kg prod)	
	Stage 1	Stage 2	Stage 1	Stage 2
A	8	3	0.08	0.05
B	6	3	0.09	0.04

Cleanup times: 4 hours A to B, B to A

The production schedule is single product campaigns and Length of production cycle is 1000 hours. **Perform the sizing of vessels for the plant.**
