

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2021****Subject Code:3170507****Date:17/12/2021****Subject Name:Computer Aided Process Synthesis****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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) Explain interior network and auxiliary network with a diagram. **03**  
 (b) Write a short note on environmental factors in process design. **04**  
 (c) Determine the minimum utility target for following stream data using temperature interval method: **07**

Stream	$T^{\text{in}}$ (K)	$T^{\text{out}}$ (K)	$mC_p$ (kW/K)
H <sub>1</sub>	650	370	10
H <sub>2</sub>	590	370	20
C <sub>1</sub>	410	650	15
C <sub>2</sub>	353	500	13

Take  $\Delta T_{\text{min}} = 10$  K.

- Q.2** (a) What is Gantt chart? Explain the importance of Gantt chart. **03**  
 (b) A given batch plant produces one single product for which stage 1 requires 8 hours/batch; stage 2, 4 hours/batch and stage 3, 7 hours/batch. If zero - wait transfer is used, what is the cycle time? How many parallel units should be placed in each stage to reduce the cycle time to 4 hours? **04**  
 (c) Discuss the pinch design approach for minimum utility requirements. **07**

**OR**

- (c) For the heat exchanger network synthesis (HENS) problem, the following stream information is available: **07**

Stream	$t^{\text{in}}$ (°C)	$t^{\text{out}}$ (°C)	$FC_p$ kW/°C
C <sub>1</sub>	60	180	3
C <sub>2</sub>	30	100	2
H <sub>1</sub>	180	40	2
H <sub>2</sub>	150	40	4

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

- Q.3** (a) Discuss the engineering ethics briefly. **03**  
 (b) Discuss in detail the phase separation of reactor effluent. **04**  
 (c) Explain the concept of multi effect distillation as possibility of energy integration. **07**

**OR**

- Q.3** (a) Briefly explain safety considerations and design approaches towards safe chemical plant. **03**  
 (b) Describe the use of grand composite curve to select utility. **04**  
 (c) Explain the heat integration in distillation column using heat pumping, vapor recompression and reboiler flashing. **07**

- Q.4** (a) Draw the possible separation sequences for 4 number of products. **03**  
 (b) Explain reactor design for complex configurations. **04**  
 (c) With neat sketch explain positioning distillation towers between hot and cold composite curves. **07**

**OR**

- Q.4** (a) Define with example: cycle time, make span, flow shop plant. **03**  
 (b) Explain in detail common industrial separation methods. **04**  
 (c) Write a short note on threshold approach temperature and optimum approach temperature for heat exchanger networks. **07**
- Q.5** (a) Explain node and saddle point in residue curve map. **03**  
 (b) Explain in brief general steps in product and process design. **04**  
 (c) Given the processing time for two products A and B, determine makespan and cycle time for manufacturing one batch of A and one batch of B using i) zero wait policy, ii) no intermediate storage policy, and iii) unlimited intermediate storage policy. **07**

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

**OR**

- Q.5** (a) Draw the superstructure for one cold stream and two hot streams. **03**  
 (b) Explain marginal vapor flows and show how it will be useful for predicting the best sequence of distillation columns. **04**  
 (c) Write a short note on Geometric concepts for reactor attainable region. **07**

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**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2022****Subject Code:3170507****Date:14/06/2022****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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) Briefly describe computer programs useful in process design. **03**  
 (b) Describe the use of grand composite curve to select utility. **04**  
 (c) Explain Step by step Procedure for Construction of attainable region for Reactor design. **07**

- Q.2** (a) Explain separation sequencing for Solid-Fluid systems. **03**  
 (b) Differentiate Flow shop plant and Job shop plant. **04**  
 (c) Describe the environmental factors in process design. **07**

**OR**

- (c) Explain the positioning of heat pump with reference to pinch temperature. **07**
- Q.3** (a) Draw the superstructure for one cold stream and two hot streams. **03**  
 (b) Explain the generalized rules for stream splitting on both sides of the pinch to satisfy MER requirements. **04**  
 (c) The following five streams are to be cooled or heated. Find out pinch point and construct the Grand Composite Curve. Here  $\Delta T_{\min} = 10^{\circ}\text{C}$  **07**

STREAM	IN( $^{\circ}\text{C}$ )	OUT( $^{\circ}\text{C}$ )	$M_{cp}(\text{kW}/^{\circ}\text{C})$
H1	159	77	228.5
H2	267	88	20.4
H3	343	90	53.8
C1	26	127	93.3
C2	118	265	196.1

**OR**

- Q.3** (a) Derive the equation for construction of residue curve. **03**  
 (b) Describe any four environmental factors to be considered in process design. **04**  
 (c) For  $\Delta T_{\min} = 20^{\circ}\text{C}$ , find out pinch point and construct the Hohmann composite curve. Find out sink ( $Q_{h\min}$ ) and source ( $Q_{c\min}$ ). **07**

STREAM	IN( $^{\circ}\text{C}$ )	OUT( $^{\circ}\text{C}$ )	$M_{cp}(\text{kW}/^{\circ}\text{C})$
H1	180	40	2
H2	150	40	4
C1	60	180	3
C2	30	105	2.6

- Q.4** (a) Describe the criteria for selection of separation methods. **03**  
 (b) Discuss the concept of multi effect distillation as possibility of energy integration. **04**

- (c) 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. **07**

Product	Stage-1	Stage-2	Stage-3
A	6 hrs	4 hrs	3 hrs
B	3 hrs	2 hrs	2 hrs

**OR**

- Q.4** (a) Explain the 'process creation' step briefly in product and process design. **03**  
 (b) Define span and cycle time for batch processes. Explain various policies with example **04**  
 (c) What is Gantt chart? Draw Gantt chart recipe AABC for zero wait transfer, No intermediate storage transfer and unlimited storage transfer policies from following processing times. **07**

Product	Stage-1	Stage-2	Stage-3
A	5 hrs	4 hrs	3 hrs
B	3 hrs	1 hrs	3 hrs
C	4 hrs	3 hrs	2 hrs

- Q.5** (a) What are the safety considerations in Process Design? **03**  
 (b) Explain the concept of stream matching in Heat Exchanger Network. **04**  
 (c) Use the marginal vapour rate (MV) method to determine a sequence for the separation of light hydrocarbons. Give rank to various sequences. **07**

Separation	MV (kmol/hr)	Separation	MV (kmol/hr)
A/B	0	B/CD	227
A/BC	163	AB/CD	435
A/BCD	340	C/D	0
B/C	0	BC/D	385
AB/C	231	ABC/D	613

**OR**

- Q.5** (a) "No heat passes across the pinch" Justify the Statement. **03**  
 (b) Explain The Role of Computers in Process Design. **04**  
 (c) Find the best distillation based separation sequence if the following data hold for marginal vapour flows. The components behave relatively ideally. **07**

Separation	A	B	C	D	E
A/B	-	-	100	1	1
B/C	1	-	-	1	1
C/D	1	100	-	-	1
D/E	1	1	100	-	-

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