Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3170507 Date:08-05-2025

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.**

			MARKS
Q.1	**(a)**	Describe briefly the role of computers in process design.	**03**
	(b)	Justify the statement "No heat should be passed across the pinch for minimum utility targeting".	**04**
	(c)	Explain the step-by-step procedure for the construction of attainable region for reactor design.	**07**
Q.2	**(a)**	Differentiate flow shop plant and job shop plant in batch operation.	**03**
	(b)	Describe the criteria for selection of separation methods.	**04**
	(c)	Discuss in brief about design opportunities and general steps in product and process design.	**07**
		OR	
	(c)	Discuss in detail the various environmental factors to be considered in process design.	**07**
Q.3	**(a)**	Explain the significance of GCC Curve in finding minimum utility requirement.	**03**
	(b)	Explain "threshold approach temperature" and "optimum approach temperature".	**04**
	(c)	Design a heat exchanger network for the following stream data. Take ΔT_{min} = 15 K, Minimum hot utility = 9.5 kW, Minimum cold utility = 12 kW, Cold pinch temperature = 413 K.	**07**

STREAM	**T_{IN}(K)**	**T_{OUT}(K)**	**MC_p (kW/K)**
H1	473	353	0.25
H2	523	313	0.15
C1	413	503	0.3
C2	293	453	0.2

OR

Q.3	**(a)**	For stream matching to be feasible near pinch, justify that $FC_h \geq FC_c$ must be satisfied in the below pinch region.	**03**
	(b)	Enlist the steps in the Pinch Design Approach to inventing a Heat Exchange Network.	**04**
	(c)	Find out pinch point and minimum utility requirements by constructing the Grand Composite Curve for below mentioned stream data using ΔT_{min} = 10°C.	**07**

STREAM	**T_{IN} (°C)**	**T_{OUT} (°C)**	**MC_p(kW/°C)**
H1	180	40	2
H2	150	40	4
C1	60	180	3
C2	30	105	2.6

Q.4 **(a)** Differentiate between overlapping and non-overlapping batch operations. **03**

(b) Discuss Unlimited storage policy with example. **04**

(c) What is Gantt chart? Draw Gantt chart for the recipe AABC for Zero wait, No intermediate storage and Unlimited storage transfer policies using the following processing times. **07**

Product	**Processing times (h)**		
A	5	4	3
B	3	2	3
C	4	3	4
Zero Cleanup Times			

OR

Q.4 **(a)** Explain cycle time and makespan for a batch process with examples. **03**

(b) Discuss Zero Wait storage policy with example. **04**

(c) Develop Gantt charts and find cycle time and makespan for single product campaigns (AAABBB) and mixed product campaigns (ABABAB) considering Zero Wait transfer policy for the following batch data. **07**

Product	**Stage 1**	**Stage 2**
A	5	2
B	2	4

Q.5 **(a)** Sketch all possible distillation column sequences for the separation of a four-component system (A, B, C and D). **03**

(b) Discuss the concept of multi-effect distillation as possibility of energy integration. **04**

(c) Find the best distillation-based separation sequence for the following data of marginal vapour flows for 5 component system. 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	-	-

OR

Q.5 **(a)** Construct three alternatives for the placement of heat engines with the background process. **03**

(b) Explain heat integration in distillation column using vapor recompression and reboiler flashing. **04**

(c) Rank the sequences to separate four components (A, B, C and D) using marginal vapor rate method using the following details: **07**

Separation	**Marginal vapour flows**	**Separation**	**Marginal vapour flows**
A/B	0	ABC/D	613
A/BC	163	B/C	0
A/BCD	340	B/CD	227
AB/C	231	BC/D	385
AB/CD	435	C/D	0

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