# 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 $\Delta T_{min} = 10°C$ | **07** |

| STREAM | IN(°C) | OUT(°C) | $M_{cp}$(kW/ºC) |
|---|---|---|---|
| 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 $\Delta T_{min} = 20°C$, find out pinch point and construct the Hohmann composite curve. Find out sink (Qhmin) and source (Qcmin). | **07** |

| STREAM | IN(°C) | OUT(°C) | $M_{cp}$(kW/ºC) |
|---|---|---|---|
| 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 **07** 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.

| 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 **04** example

**(c)** What is Gantt chart? Draw Gantt chart recipe AABC for zero wait transfer, No **07** intermediate storage transfer and unlimited storage transfer policies from following processing times.

| 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 **07** separation of light hydrocarbons. Give rank to various sequences.

| 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 **07** marginal vapour flows. The components behave relatively ideally.

| 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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