Seat No: _____ Enrollment No: _____

# PARUL UNIVERSITY

## FACULTY OF ENGINEERING & TECHNOLOGY

**B.Tech. Summer 2018 - 19 Examination**

**Semester: 8** **Date: 03/05/2019**
**Subject Code: 03103454** **Time: 10:30 to 1:00 pm**
**Subject Name: Process Synthesis** **Total Marks: 60**

**Instructions:**
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

**Q.1 Objective Type Questions - (All are compulsory) (Each of one mark)** **(15)**

1. In basic HENS problem stream to be cooled is called as
   (a) Hot Stream (b)Cold Stream (c) dependent on temperatures (d) above statement has insufficient details
2. As per Pinch design approach the number of exchangers for each partition as,
   a) N+1 b) N-1 c) N d) N+2
3. Which transfer policy allows the possibility of storing material inside the vessel?
   a) zero wait. b) No intermediate storage c) Unlimited intermediate storage
   d) none of above
4. Flow shop plants are often denoted as
   a) multi-purpose plant. b) multi products plant c) single product plant d) none of above
5. Which mode of operation is more efficient in terms of cycle time?
   a) Overlapping. b) non-overlapping. c) Both A & B. d) none of above
6. Batch processes are commonly used to manufacture speciality chemicals with _____ life cycle.
7. In _____ operation, each batch is processed until the presiding one is completed.
8. _____ plants in which all products are required all stages following the same sequence of operation.
9. _____ plant where not all products require all stages and follow same sequence.
10. The batch at any stage would be transferred immediately to the next stage is known as _____ transfer policy.
11. Give full name of : HCC

Define following terms:

12. Flowshop plant
13. Jobshop plant
14. No intermediate storage
15. Unlimited intermediate storage

**Q.2 Answer the following questions. (Attempt any three)** **(15)**

A) A given batch plant produces one single product for which stage 1 requires 8 hours/batch; stage 2, 4 hours per batch; and stage 3, 7 hours per 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?

B) Given the processing times for three products A, B, C, below, determine with a Gantt chart the make span and cycle time for manufacturing two batches of A, 1 of B, and 1 of C for the following cases:
   1) Zero-wait policy with sequence BAAC.
   2) Same as (1) but with unlimited intermediate storage policy (UIS).

C) Write the Heuristics for designing Separation process.

D) Discuss side stripper and side enricher configuration in brief.

**Q.3** A) Formulate the LP transhipment problem for minimum utility cost for the process **(07)**

streams and utilities given below:

| | $FCp$(KW/K) | $T_{in}$(K) | $T_{out}$(K) |
|---|---|---|---|
| H1 | 10 | 450 | 270 |
| C1 | 5 | 360 | 480 |
| C2 | 5 | 300 | 400 |
| C3 | 4 | 300 | 400 |

HP Steam 500K, \$80/KWyr LP Steam 420K, \$60/KWyr
CW 300K, \$20/KWyr Refrigerant 260K, \$100/KWyr
HRAT = 10K

B) Find the best distillation-based separation sequence if the following data hold for marginal vapor flows using a branch and bound search. The components behave relatively ideally. (08)
Prove that you have the best answer by listing the total marginal vapor flows for all sequences

| | *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 | — | — |

OR

B) Find the best distillation-based separation sequence if the following data hold for marginal vapor flows using a branch and bound search. The components behave relatively ideally. (08)
Prove that you have the best answer by listing the total marginal vapor flows for all sequences

| | *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 | — | — |

**Q.4** A) Discuss flows for intercooled or interheated columns. (07)

OR

A) Discuss the effect of changing thermal condition of feed. (07)

B) (08)

| Stream | $T_{in}$, K | $T_{out}$, K | FCp, kW/K | Comment |
|---|---|---|---|---|
| H1 | 430 | 340 | 15 | Liquid |
| C1 | 310 | 395 | 7 | Liquid |
| C2 | 370 | 460 | 32 | Vapor |

For a $\Delta T_{min}$ of 10 K draw GCC curve & find utility requirements.