

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (NEW) - EXAMINATION – SUMMER 2017****Subject Code: 2170507****Date: 09/05/2017****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)** Calculate the number of possible sequences of ordinary distillation column for 10 number of product and draw only direct and indirect sequences. **07**

**(b)** Consider a plant consisting of two stages that manufactures two products A and B. Demands are 500000 kg/yr for A and 300000 kg/yr for B and the production time considered is 6000 hr. Data for processing time, size factors and cleanup times are as follows: **07**

	Processing time (hr)		Size factors (m <sup>3</sup> /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 hr A to B and B to A				

The production schedule is single product campaigns and length of production cycle is 1000 hr. Perform the sizing of vessels for the plant.

**Q.2 (a)** Find minimum utility targets and pinch point for  $\Delta T_{\min} = 20$  K using TI method for heat exchanger network synthesis for the following streams. **07**

Stream	$T_{\text{in}}$ K	$T_{\text{out}}$ K	$FC_p$ kW/K
H1	430	340	15
C1	310	395	7
C2	370	460	32

**(b)** Discuss the Engineering Ethics briefly **07**

**OR**

**(b)** Write a short note on role of computers in product and process design. **07**

**Q.3 (a)** What are the residue curves? Draw the residue curves for a system containing octane, ethylbenzene and 2-ethoxyethanol with boiling point 398.8 K, 409.2 K and 408.1 K respectively. 2-ethoxyethanol makes binary azeotrope with octane and ethylbenzene at 389.1 K and 400.1K respectively. **07**

**(b)** Discuss the procedure for reactor network design using concept of attainable region. **07**

**OR**

**Q.3 (a)** What is the principle of reaction invariance? Explain using example of steam reforming of methane. **07**

- (b) Use the marginal vapour rate (MV) method to determine the 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	277
A/BC	163	AB/CD	435
A/BCD	340	C/D	0
B/C	0	BC/D	385
AB/C	231	ABC/D	613

- Q.4** (a) Prepare the table for HCC, CCC and GCC for the following system. Explain the significance of GCC curve with reference to utilities requirement. Assume  $\Delta T_{\min} = 20 \text{ K}$  **07**

Stream	$FC_p$ kW/K	$T_{\text{in}}$ K	$T_{\text{out}}$ K	$h$ W/m <sup>2</sup> K
H1	10000	600	450	800
H2	10000	500	400	700
ST		650	650	5000
C1	15000	450	590	600
CW		300	325	600

- (b) Discuss approach used by Papoulias and Grossman for stream matching. **07**

**OR**

- Q.4** (a) Discuss approach used by Linhoff and Hindmarsh for stream matching at pinch. **07**

- (b) Define : approach temperature, threshold approach temperature, optimal approach temperature, minimum approach temperature **07**

- Q.5** (a) Explain the concepts of heat pump and heat engine. Discuss scope of heat and power integration in chemical process plant using this concept. **07**

- (b) A given batch plant produces one single product for which stage 1 requires 8 hr/batch, stage 2, 4hr/batch and stage 3 , 7 hr/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 hr. **07**

**OR**

- Q.5** (a) Define span and cycle time for batch processes. Explain various policies with example. **07**

- (b) Discuss the concept of multi effect distillation as possibility of energy integration. **07**

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