

Ans

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
DEPARTMENT OF CHEMICAL ENGINEERING
MID SEMESTER EXAMINATION 2015-16 (SPRING)

Computer Aided Process Engineering (CH30016)

Number of Students -80

FULL MARKS – 30

Answer all the questions

NAME : _____ Roll No:

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Submit this Sheet duly filled in along with your Answer Book

1. From the following stream table, design the MER heat exchanger network
- Without Stream-splitting
 - With Stream-splitting
 - Explain with a numerical example, how do you optimize the stream splitting strategy ?

Stream Type	CP (kW/ °C)	T _s (°C)	T _t (°C)
1. Cold	10	150	450
2. Hot	30	470	270
3. Cold	10	130	430

Assume :

- $\Delta T_{\min} = 20\text{ }^{\circ}\text{C}$
- Pinch temperature for the hot stream is 470°C.

$$3 + 2 + 3 = 8$$

2. A multi-component non-ideal liquid stream is continuously “flashed” in a drum to get vapour and liquid from the top and bottom of the drum respectively. Develop a lumped parameter model for the system considering heat balance, component balance, VLE and any other relevant phenomena. Draw the Information Flow Diagram highlighting the convergence block. 5

3. Develop the non-dimensional distributed parameter model for a counter current double pipe heat exchanger where the hot fluid is flowing through the inner pipe. Comment on the method of solution you would deploy for the two resulting PDE. 5

P.T.O.

NOTE: Do not ask any question at the Examination Hall. If in doubt, make suitable assumptions and proceed. Handwriting and figures should be neat. Parts of a question should be answered together, in one place.

4. (a) What do you mean by the "Composite Graph" in Pinch Analysis of Heat Exchangers Network?

From a process flow-sheet, the following "Stream table" has been extracted.

Stream Type	CP (MW/ °C)	T _s (°C)	T _t (°C)
1. Cold	2	20	135
2. Hot	3	170	60
3. Cold	4	80	140
4. Hot	1.5	150	60

Using the "Problem table method" based on the MER design, find out assuming $\Delta T_{\min} = 20^\circ\text{C}$:

- (b) Pinch temperature

- (c) Minimum Cold & Hot utilities requirement

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- (d) Draw the Heat Exchanger Network (Grid representation) and fill up the relevant data into following tabular format:

	T _{h,in}	T _{h,out}	T _{c,in}	T _{c,out}	ΔH
HE1					
HE2					
HE3					
HE4					
HE5					
Heater					
Cooler					

- (e) Based on the given cost data, find out the Annual Cost of Hot Utility and Cold Utility

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Cooling water: T_s = 20 °C, T_t = 30 °C, and Cost = 0.0075 Rs./kg
 Steam (saturated): T = 258 °C, Latent Heat = 1,676 kJ/kg and Cost = 0.03 Rs./ kg
 Equipment operability 8,000 hr/yr.

$$2+1+2+5+2= 12$$