INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
DEPARTMENT OF CHEMICAL ENGINEERING
MID SEMESTER EXAMINATION 2017-18 (SPRING)

Computer Aided Process Engineering (CH30016)

Number of Students - 98 FULL MARKS – 30 **Answer all the questions**

NAME : _____ Roll No: | | | CH | | | | | |

Submit this Sheet duly filled in along with your Answer Book

1. What is "Hot and Cold Composite curve" in Pinch Analysis for Heat Exchangers Network Design ? Based on the stream table of Q-3, develop the composite curve and show graphically the effect of ΔT_{min} on the consumption of hot and cold utility.

8

2. From the following stream table, design the MER heat exchanger network

(a) Without Stream-splitting
(b) With Stream-splitting
(c) Explain how do you optimize this stream splitting strategy ?

Stream Type	CP (kW/ °C)	T_s (°C)	T_t (°C)
1. Cold	5	250	550
2. Hot	15	570	370
3. Cold	5	230	530

Assume :

- $\Delta T_{min} = 20$ °C
- Pinch temperature for the hot stream is 570°C.

4 +2 + 4 = 10

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.**

Submit this Sheet duly filled in along with your Answer Book

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

Stream Type	CP (MW/ °C)	T_s (°C)	T_t (°C)
1. Hot	0.2	150	50
2. Hot	0.1	170	40
3. Cold	0.3	50	120
4. Cold	0.5	80	110

Using the "Problem table method'' based on the MER design,
and assuming ΔT_{min} = **10 °C :**
Calculate and fill up the boxes below and submit with the answer script:

(a) Pinch temperature
(b) Minimum Cold & Hot utilities requirement

(c) 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 (MW)
HE1					
HE2					
HE3					
HE4					
HE5					
Heater					
Cooler					

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

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+2+6+2= 12**

Submit this Sheet duly filled in along with your Answer Book