Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER/DECEMBER 2018

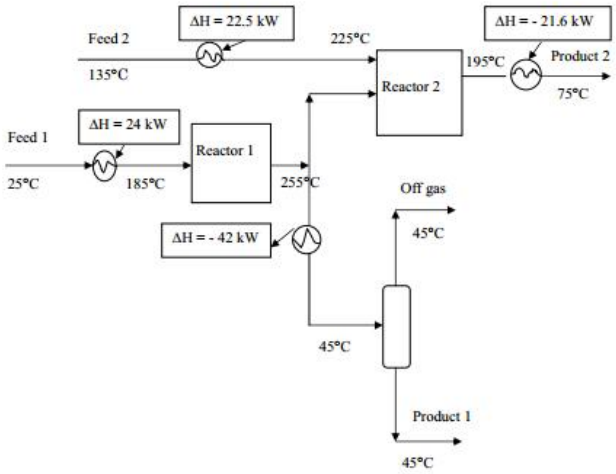
SUBJECT: PINCH TECHNOLOGY [CHE4021]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** questions.
- Use of linear graph sheet is permitted.
- Missing data may be suitably assumed.

1A	Explain the different strategy available in the literature for energy integration.	**03**
1B	The sequence of the process design tends to follow the onion model. Explain each of the hierarchy represented by the layers in the "onion model".	**04**
1C	A process flow diagram of a typical process is shown in figure below. Extract the stream data for this process 	**03**
2A	Find the minimum utilities required for four stream case (shown below) for energy integration with ΔT_{min} =10 ^{0}C by constructing composite curves.	**06**
2B	Explain the importance of Minimum temperature difference for Pinch Design Method. Show the effect of ΔT_{min} on cost with approximate composite curve.	**04**

stream	T_S (^{o}C)	T_t (^{o}C)	CP (kW/^{o}C)
C1	20	150	2
C2	50	140	4
H1	170	60	3
H2	160	40	1.5

3A The stream data for the process is given in Table below. For this process compute the amount of hot and cold utility required by considering ΔTmin as 10°C using Problem Table Algorithm (PTA) analysis. **04**

Stream	Supply Temp. (^{O}C)	Target Temp. (^{O}C)	Heat Capacity Flow rate (MW $^{0}C^{-1}$)
Hot	415	40	0.22
Hot	50	35	1.2
Cold	25	380	0.18
Cold	30	370	0.06
Cold	115	120	25

3B Discuss the different feasibility criteria in detail for Pinch Design Methods of Heat Exchange Networks (HENS) Synthesis. (Minimum three points to be explained in detail) **06**

4A Explain the significance of grand composite curve in pinch design method. **03**

4B For a particular process, the total area targeted found to be 3500 m^2 using Pinch Design Methods. Also, the present problem requirement of minimum hot and cold utility are found to be 60 MW and 25 MW, respectively. The Cost of hot utility=100 ($.kW^{-1}.y^{-1}), Cost of cold utility =10 ($.kW^{-1}.y^{-1}), Installed capital cost = 30000 × $A^{0.83}$, Rate of interest = 13% and Plant life = 7 year. Conversion of the capital cost into annual capital cost using conversion factor as: = $\frac{i(1+i)^n}{(1+i)^n-1}$. Target the cost for this process (Total Annual Cost). **04**

4C What is meant by threshold problem in Pinch analysis? Explain the usage of utilities as a function of ΔT_{min} (Minimum temperature difference) for threshold problems. **03**

5A For a process the stream data together with utility data given below. The overall heat transfer coefficient U is constant and equal to 2 kW.$m^{-2}K^{-1}$ for all exchangers. Where ΔT_{min} is selected as 10 ^{o}C. From PTA the following results are found: Amount of hot utility: 100 kW, Amount of cold utility: 15 kW, Pinch point: 45^{0}C.

Stream	Supply Temp. (^{O}C)	Target Temp. (^{O}C)	Heat Capacity Flow rate (kW $^{0}C^{-1}$)
C1	40	120	2
H1	120	60	3
C2	50	110	4
H2	130	40	1.5
Steam	190	189	---
Water	25	26	---

08

(i) Construct a balanced cold and hot composite curves. (02

(ii) Evaluate the unknown temperatures of balanced hot and cold composite curves 02

(iii) Evaluate a Cumulative enthalpies at different temperature intervals along with known interval temperatures of BHCC and BCCC 02

(iv) Target the heat exchange area for this process 02)

5B Classify the types of utilities used in process industry. **02**

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