Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

MAKE UP EXAMINATIONS, DECEMBER 2017

SUBJECT: PINCH TECHNOLOGY [CHE 4021]

REVISED CREDIT SYSTEM

Time: 3 Hours Date of Examination: 27/12/2017 MAX. MARKS: 50

Instructions to Candidates:

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

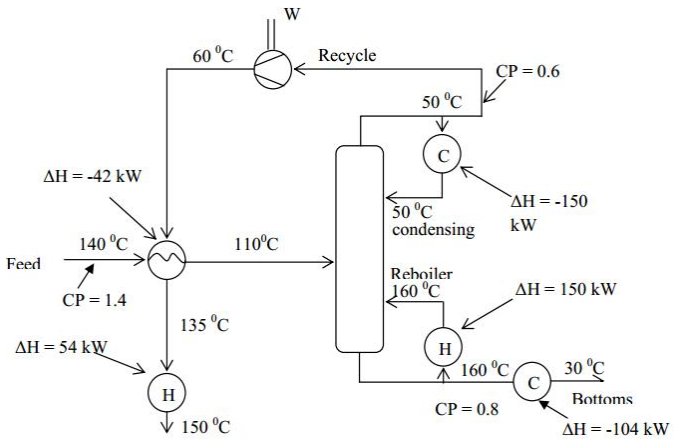
1A.	The sequence of the process design tends to follow the onion model. Explain each of the hierarchy represented by the layers in the "onion model".	**04**
1B.	Explain the key steps in Pinch Technology procedure	**04**
1C.	A process flow diagram of a typical process is shown in Fig. 1C. Extract the data for hot and cold streams for this process  Figure: 1C: Process flow diagram for Problem 1C.	**02**
2A.	Explain the importance of Minimum temperature difference for Pinch Temperature. Show the effect of ΔT_{min} on cost with approximate composite curve.	**04**
2B.	Find the minimum utilities required for four stream case for load integration with ΔT_{min} =20 ^{0}C by constructing composite curves. The stream data given in Table 2B. Table 2B: The stream data for the process. stream | T_S (°C) | T_t (°C) | CP (kW/°C) C1 | 25 | 120 | 1 C2 | 40 | 100 | 2 H1 | 110 | 40 | 1 H2 | 60 | 40 | 3	**06**
3A.	The stream data for the process is given in Table 3A. For this process compute the amount of hot and cold utility required considering ΔT_{min} as 10°C by making use of Problem Table Algorithm.	**06**

Table 3A: The stream data for the process

Stream	Supply Temp. (^{O}C)	Target Temp. (^{O}C)	Heat Capacity Flow rate (MW $^{0}C^{-1}$)
Hot	415	25	1
Hot	50	20	0.5
Cold	25	380	0.1
Cold	30	420	1
Cold	90	120	1
Hot	300	35	0.1

3B Discuss the Capital-energy trade-off for threshold problems in HENS **04**

4A. For a process the stream data together with utility data Table 4A. The overall heat transfer coefficient U is constant and equal to 0.123 $kW.m^{-2}K^{-1}$ for all exchangers. where ΔT_{min} is selected as 10 ^{o}C. From PTA the following results are found: Amount of hot utility: 114 kW, Amount of cold utility: 0.0 kW, Pinch point: 75^{o}C

Table 4A: The stream and utility data for the process

Stream	Supply Temp. (^{O}C)	Target Temp. (^{O}C)	Heat Capacity Flow rate (kW $^{0}C^{-1}$)
H1	180	140	1.4
H2	150	90	2.5
C1	70	150	4
HU	190	189	

(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**

4B Discuss the subset and loops affecting the minimum number of units in HENS **02**

5A For a particular process, the total area targeted found to be 5000 m^2 using Pinch Design Methods. Also, the present problem requirement of minimum hot and cold utility are found to be 5 MW and 3 MW, respectively. The Cost of hot utility=100 ($\$.kW^{-1}.y^{-1}$), Cost of cold utility =10 ($\$.kW^{-1}.y^{-1}$), Installed capital cost = $40000 \times A^{0.83}$, Rate of interest = 10% and Plant life = 5 year. Target the cost for this process (Total Annual Cost). **04**

5B. Discuss the shell targeting procedure for Heat Exchange Networks (HENS) Synthesis. **06**

****