CHE 4253

ASSIGNMENT 2

ROBLEM #1(Individual)

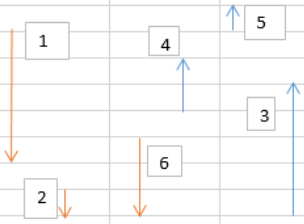
Consider the following data

FCp (KW/C)	Initial Temperature	Target Temperature
1.5	170	60
2	45	30
2.7	20	132
1.5	80	140
0.4	160	195
2.5	70	30

a) Construct your Pinch Tableau in Excel so that you can identify minimum utility and pinch temperature

Stream ID	Req. Action	Source Temp.	Target Temp	Delta Enthalpy	FCp
1	Req. Cooling	170	60	-165	1.5
2	Req. Cooling	45	30	-30	2
3	Req. Heating	20	132	302.4	2.7
4	Req. Heating	80	140	90	1.5
5	Req. Heating	160	195	14	0.4
6	Req. Cooling	70	30	-100	2.5

Adjusted Temp
200
165
145
137
85
65
55
40
25



T Interval	H interval	Cascade	MW	
35	-14	Cascade	148.4	Min Heat Utility
20	30	16	134.4	
8	0	16	164.4	
52	-140.4	-124.4	164.4	
20	-24	-148.4	24	
10	13	-135.4	0	Pinch= 70 F
15	-3	-138.4	13	
15	27	-111.4	10	
			37	Min Cool Utility

The H Interval is calculated by taking the T Interval and multiplying it by the FCp of each stream keeping in mind when you are heating and cooling the streams.

The cascade is just the addition of the H Intervals

You can use Solver to change the Min Heat Utility to solve the pinch to 0. This will also give you the Min Cool Utility

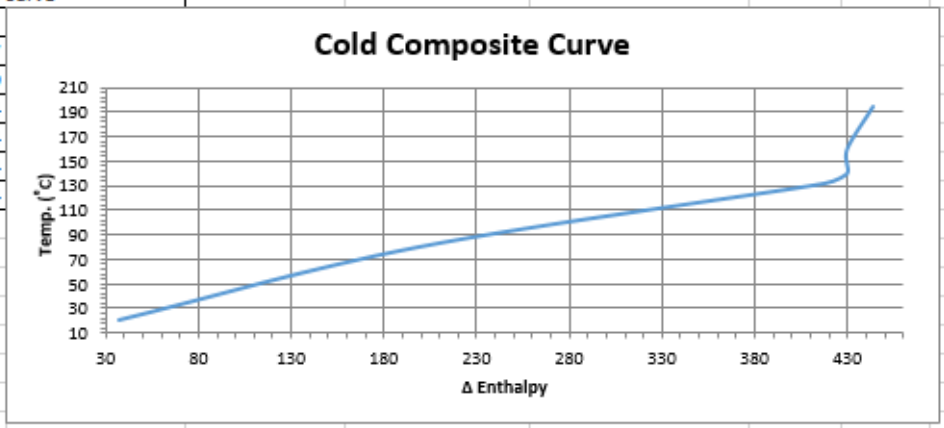
b) Draw composite curves for one selected value of HRAT.

Stream ID	Req. Action	Source Temp.	Target Temp	Delta Enthalpy	Thermal Capacity
1	Req. Cooling	170	60	165	1.5
2	Req. Cooling	45	30	30	2
3	Req. Heating	20	132	302.4	2.7
4	Req. Heating	80	140	90	1.5
5	Req. Heating	160	195	14	0.4
6	Req. Cooling	70	30	100	2.5

DTmin	Pinch Temp
10	70

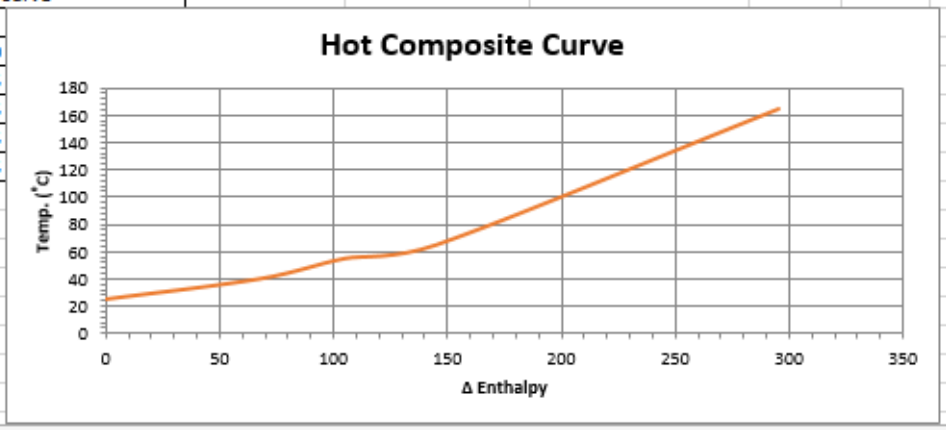
Cold Composite Curve

Temp	Enthalpy
20	37
80	199
132	417.4
140	429.4
160	429.4
195	443.4



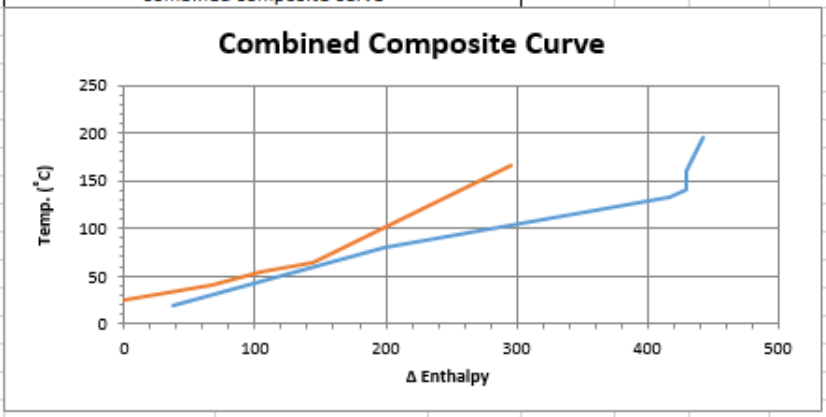
Hot Composite Curve

Temp	Enthalpy
25	0
40	67.5
55	105
65	145
165	295



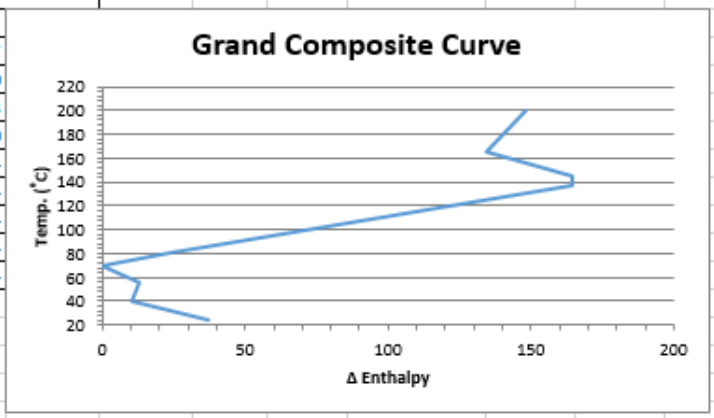
Pinch Temp	Min. Cooling (kW)	Min. Heating (kW)
70	37	148.4

Combined Composite Curve



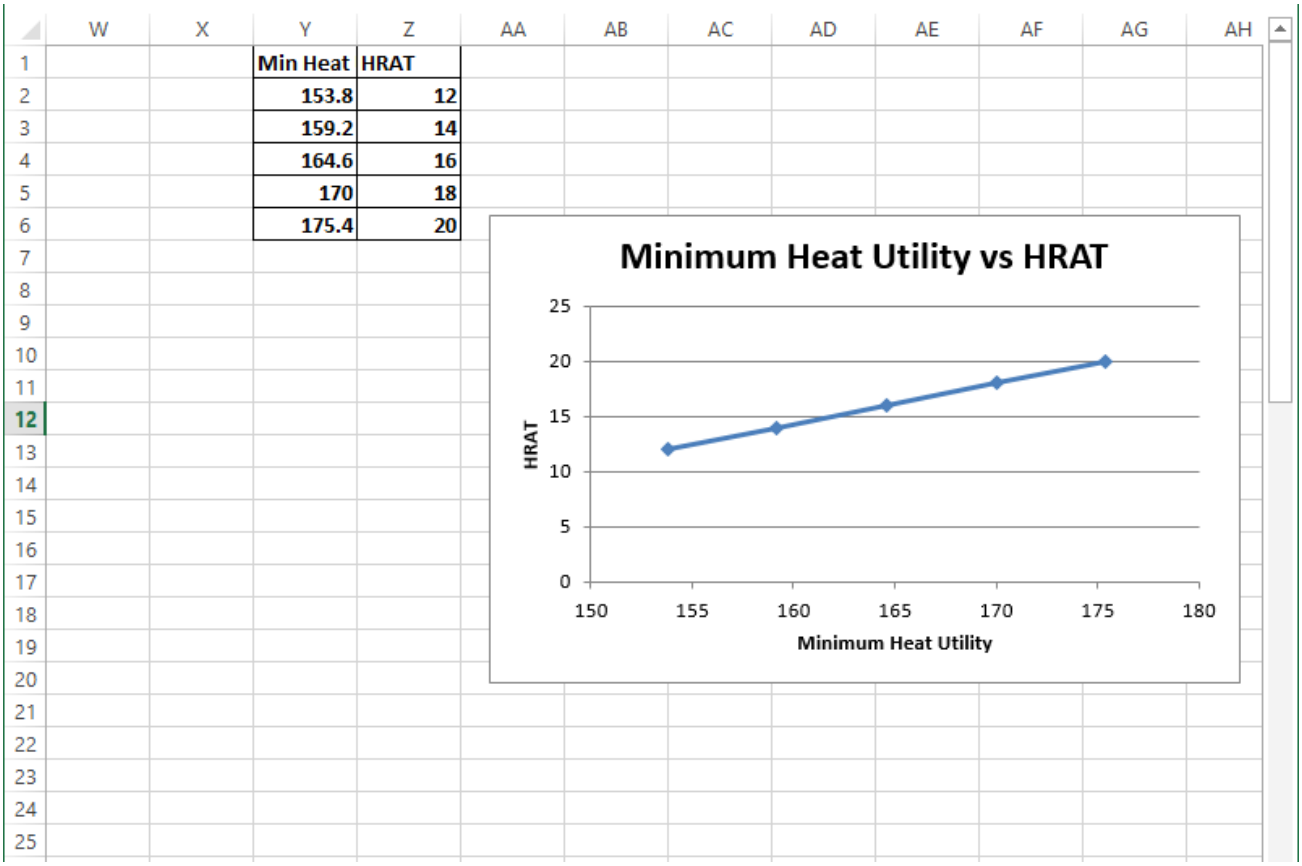
Grand Composite Curve

Temp	Enthalpy
25	37
40	10
55	13
70	0
81	24
137	164.4
145	164.4
165	134.4
200	148.4



Remember to use the combined FCp for streams that overlap in temperature when making composite curves.

c) Make a graph of the minimum utility and pinch temperature as a function of the minimum temperature difference (HRAT) in the network.



Pretty straightforward. Just redo what was done in Part a() for different Delta Temp. Then plot them as shown above.

d) Choose one value of minimum temperature difference (HRAT) (pick one that will render decent overlap) and draw the grand composite curve. Consider that you have available utility at 100 °C, at 120 °C and at 260 °C where you have increasing price with increasing temperature. Determine the optimum utility usage.

Stream ID	Req. Action	Source Temp.	Target Temp	Delta Enthalpy	Thermal Capacity	Adj. Source Temp	Adj. Target Temp.
1	Req. Cooling	170	60	165	1.5	165	55
2	Req. Cooling	45	30	30	2	40	25
3	Req. Heating	20	132	302.4	2.7	25	137
4	Req. Heating	80	140	90	1.5	85	145
5	Req. Heating	160	195	14	0.4	165	200
6	Req. Cooling	70	30	100	2.5	65	25

T Interval	H interval		MW	
35	-14	Cascade	148	Min Heat Utility
20	30	16	134	
8	0	16	164	
52	-140.4	-124.4	164	
20	-24	-148.4	24	
10	13	-135.4	0	Pinch= 70 F
15	-3	-138.4	13	
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Adjusted Temp
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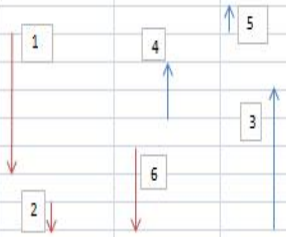
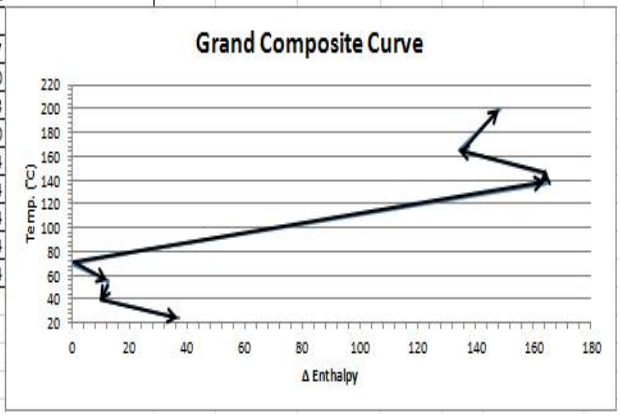
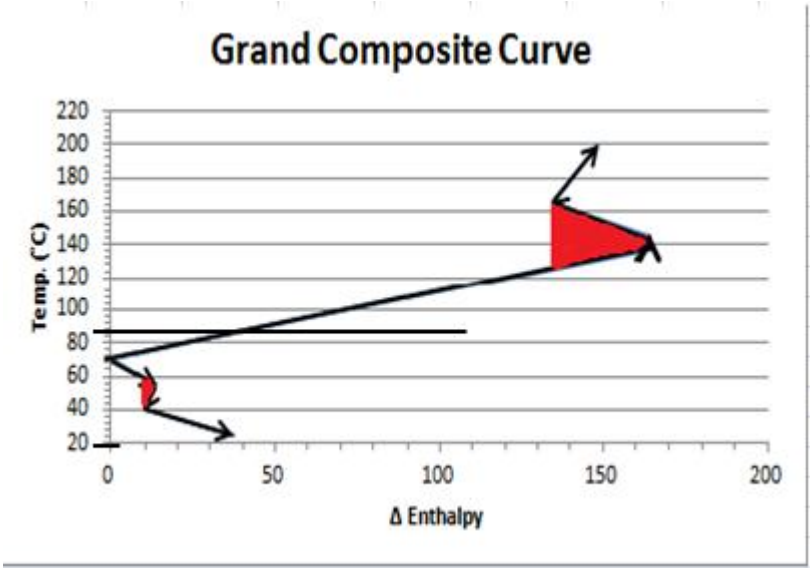


Grand Composite Curve	
Temp	Enthalpy
25	37
40	10
55	13
70	0
80	24
137	164.4
145	164.4
165	134.4
200	148.4





e) Assume that your cooling water is available at 15 °C. Determine the outlet temperature that will minimize its flowrate. What is the cooling water outlet temperature in that case? Discuss solutions in the case where the cooling water to be returned to the cooling tower cannot exceed 30 °C.

Sol) The Cooling Water Line cannot cross the Grand Composite Curve and only touch one of the points on the graph. The Line should start at the end of the Grand Composite Curve and end at the median of the first pocket on the y axis. This provides a temperature of 45˚C.

If the cooling water cannot exceed 30˚C, adding a refrigeration system would provide the solution but the utility of the system would also go up.

Cold Water Points	
Delta Enthalpy	Temp.
12.5	40
0	45