Seat No.: ________ *Enrolment No.___________*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 711606N **Date: 06-01-2014**

Subject Name: Energy and Mass Integration

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full mark.**

Q.1 **(a)** Explain preheating or cooling of feed for energy integration in distillation. **04**

(b) Explain step by step procedure for generating inter-cooling and inter-heating curves for energy integration in distillation. **05**

(c) Explain use of GCC curve for HENS with its interpretations for left and right facing noses. **05**

Q.2 **(a)** What is stream splitting? Can stream splitting reduce number of exchanger units for HENS? **04**

(b) Explain multi effect distillation. **04**

(c) Write step by stem procedure to estimate optimum temperature driving force for design of heat exchanger network by short cut method. **06**

OR

(c) "No heat should cross pinch for inventing a heat exchanger network for minimum utility requirements": Justify the statement. **06**

Q.3 Determine the minimum utility consumption for the hot and cold streams given below using LP transshipment formulation. **14**

	FCp (kW/°C)	T_{in} (°C)	T_{out} (°C)
H1	1.60	100	430
H2	3.27	180	350
H3	2.60	200	400
C1	2.80	440	150
C2	2.38	520	300
C3	3.36	390	150

Heating Utility : 230 ºC, Cooling Utility : 23 ºC, ΔT_{min} = 15 ºC

Write a model for minimum utility cost if H1 and C2 are not allowed to exchange heat for the above Heat Exchanger Network Synthesis (HENS) problem.

OR

Q.3 For the Heat Exchanger Network Synthesis (HENS) problem following stream information is available: **14**

	Fcp (MW/K)	T_{in} (°C)	T_{out} (°C)
H1	1.3	400	110
H2	2.2	340	120
C1	1.6	160	400
C2	1.8	110	260

Draw Composite Curve and find out pinch point for ΔT_{min} = 10 ºC.
Estimate the fewest number of heat exchangers needed if heat is not allowed to flow through pinch.

Q.4 **(a)** Discuss the effect of minimum temperature driving force, ΔT_m for design of heat exchanger network. **05**

(b) Determine the minimum utility consumption for the hot and cold streams given below using ΔT_{min} = 20 ºC. **09**

	Fcp (MW/K)	T_{in} (°C)	T_{out} (°C)
H1	2.376	590	400
H2	1.577	471	200
C1	1.600	200	400
C2	1.600	100	430

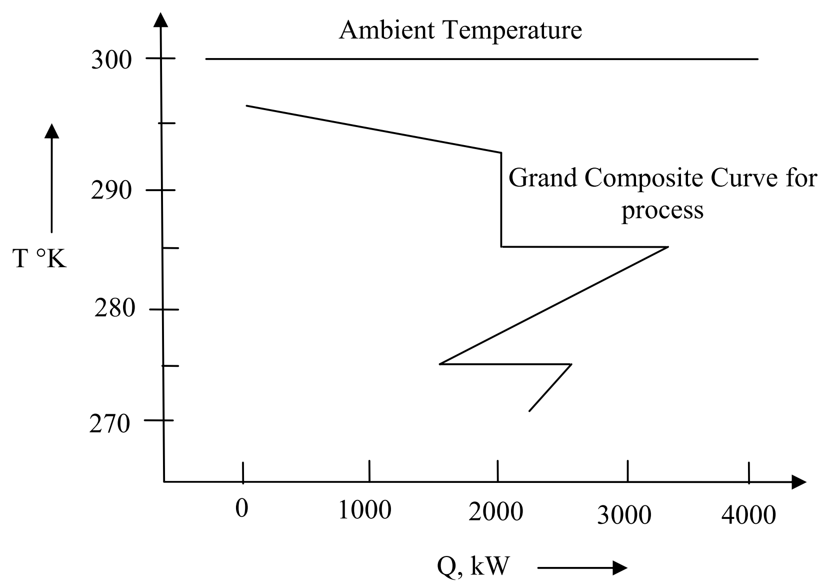
OR

Q.4 **(a)** Write steps for pinch design approach to inventing a heat exchanger network. **05**

(b) Determine minimum utility targets and formulate MILP problem for the minimum number of exchanger units. **09**

Stream	Fcp (MW/K)	T_{in} (°C)	T_{out} (°C)
H1	1.3	400	110
H2	2.2	340	120
C1	1.6	160	400
C2	1.8	110	260

Q.5 **(a)** How many refrigeration cycles should you use for the following sub-ambient process? The grand composite curve (GCC) is based on a driving force of 2°K. The temperatures shown on the ordinate are cold-side temperatures. Indicate clearly why you have arrived at the answer you have. **05**



(b) Compare the sequential optimization and simultaneous optimization approaches for HENS. Write detailed model for simultaneous optimization. **09**

OR

Q.5 **(a)** Explain the analogy of Heat Exchanger Network Synthesis and Mass Exchanger Network Synthesis. **07**

(b) Give any case study of mass exchanger network synthesis discussing the method used for analysis. **07**

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