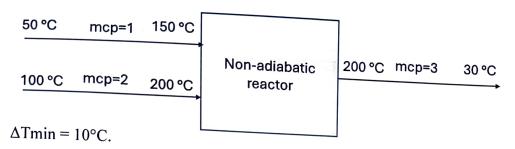
AAE- E3007 Process Into Exam 2.12.2025 at 9-12	gration and Energy Optimization D, (5 cr)	1 2	3	4 5	6	7
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EXAM PART A: Answer part A questions on separate answer sheet

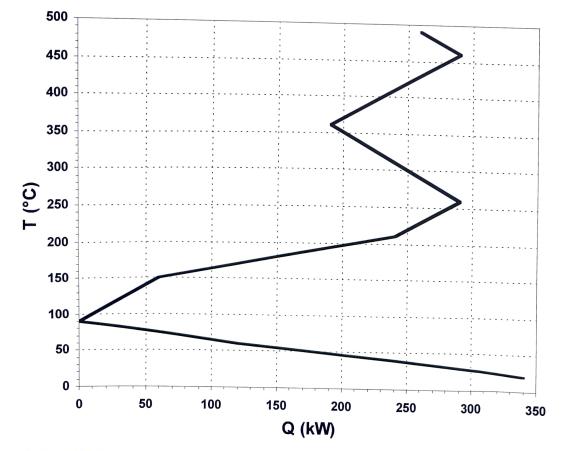
1. Pinch composite curves. [8 p]

We have the following process:



- a) Extract the pinch streams (3p)
- b) Draw the hot and cold composite curves. (2p)
- c) What are the minimum hot and cold utility consumptions? (2p)
- d) What is the pinch temperature? (1p)

2. Grand composite curve. [5 p]



 Λ Tmin = 20°C.

What are the minimum hot and cold utility consumptions, and what is the pinch temperature? (5p)

3. Transshipment model. [7 p]

Using the data below, formulate the problem as a LP TRANSSHIPMENT MODEL.

DATA

DAIA				
Stream	T _{start} (°C)	T_{target} (${}^{o}C$)	m*cp (kw/K)	Q (kW)
H1	120	80	4	
C1	50	90	1	
C2	40	150	1	
Steam	200	200		
Cooling water	20	20		
Δtmin	10 °C			

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5 a. Why are the fixed costs in the NoDH configuration higher than in the other scenarios? [2 p]		All NoDH NoDC NoPV												x	
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5.b: Why are the overall production capacities highest in the NoStor configuration? [2 p]

An LP model has 4 variables and 5 inequality constraints. After converting the model into canonical format by introducing slack/surplus variables:					
a) How many variables does the model contain? [1 p]					
b) How many basic solutions does the model potentially have? [2 p]					

7. Combined heat and power modelling [15 p]

A CHP plant can operate at the extreme points 1-4 shown in the following table and linearly between them.

- a) Draw the characteristic operating region in the PQ plane in the space to the right of the table [2 p]
- b) Compute the energy efficiency of the plant at each point and mark it in the table [1 p]
- c) Plant is producing 150MW power and 150MW heat. Compute fuel consumption and efficiency and mark them on **row** c of the table [2 p]

Formulate the following problems as LP or MILP models. Tell if each model is convex or non-convex.

- d) Fuel price is C_F , market price for power is C_P and heat price is C_Q (E/MWh). Heat demand is Q. Using **extreme point formulation** for CHP, formulate a model for maximizing operative profit [5 p]
- e) If the plant is shut down, no fuel is consumed, and no power is generated. Extend the previous model to include the option of shutting down the plant. [5 p]

Point	Power	Heat	Fuel	4.b	4.a Picture
	generation	production	consumption	Efficiency	
	P (MW)	Q (MW)	F (MW)	(%)	
1	100	0	300		
2	200	0	500		
3	100	100	250		
4	200	200	440		
c	150	150			

7.d: Define model below: decision variables, objective function, and constraints.

7.e: Additional or modified model components: