TEST 1

Undergraduates not in the combined Bachelor-Master program: *In groups of 2*
Graduates and Undergraduates in the combined Bachelor-Master program: *Individual*
First Discussion session (in my office) due no later than Feb 13. Test due on Feb 18. Make appointments.

Consider the grassroots design of a crude unit. Succinct report please!!! Stream info and economic data follow:

Hot Streams

	TCR	MCR	LCR	KERO	LGO	HGO	OVHD	HVGO	LVGO	SR1	SR2	SRQ
Fcp [kW/C]	106.20	117.81	233.98	33.79	31.98	25.05	122.69	130.94	47.40	66.32	28.23	24.20
Tin [C]	140.18	210.00	303.56	170.11	248.82	276.98	117.71	250.55	178.55	359.97	290.00	359.55
Tout [C]	39.53	162.98	270.23	60.00	110.00	121.91	50.00	90.00	108.87	290.00	115.00	280.00
h [kW/C.m^2]	0.26	0.33	0.41	0.45	0.72	0.57	0.72	0.26	0.60	0.47	0.47	0.47

Cold Streams

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Fcp [kW/C]	200.04	223.73	228.00	230.91	236.67	246.35	255.25	265.83	328.06	371.49	373.8	413.6
Tin [C]	30.00	130.00	145.00	153.74	161.90	185.00	216.66	234.84	270	290	310	330
Tout [C]	130.00	145.00	153.74	161.90	185.00	216.66	234.84	270.00	290	310	330	350
h [kW/C.m^2]	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

The system has two cold streams. The second cold stream is represented by piece wise sections (C2-C12) because the FCP varies with temperature (the stream vaporizes).

Economic Data

Furnace Utility Costs ($/Kw-yr)	$100.00	Maximum area per shell (m^2)	500
Area addition costs ($/$m^2$)	$271.20	Installation cost as % of equipment cost	50%
Fixed exchanger cost ($)	$127,129	Furnace Efficiency	80%

1) Calculate the cost of cold utility (paper provided) and perform supertargeting (Be careful with the number of units you calculate).
2) Design the heat exchanger network according to the Pinch Design Method as it was presented in class (Pinch matches followed by tick-off rule). Remember you do not have 12 cold streams, but rather 2.
3) Assume that the heat exchanger coefficient varies with each match and consider better area targeting as well as shell targeting. (Consult Smith book for this cases). Repeat 1 and 2. Keep this assumption from now on.
4) Assume now that you do not enforce the tick-off rule. Follow the suggestions of Linnhoff and Ahmad (paper provided) to use the Driving Force Plot to improve the network. Avoid excessive splitting as much as possible (3 branches is the maximum accepted in practice).
5) Use Loops and paths to improve the network further (less area, less units, etc). Can you reduce splitting?
6) Consider cross-pinching (see Linnhoff and Ahmad paper) before and after step 5.
7) Perform a literature search to understand and quantify the furnace efficiency changes with inlet cold stream temperature. Will these affect your design? If so, explain what do you expect happening in some quantitative way.