B. CHEMICAL ENGINEERING FINAL EXAMINATION, 2008

(2nd Semester, Supplementary)

CHEMICAL PROCESS SYNTHESIS

Time : Three hours Full Marks : 100

Answer question ***no. 3*** and any ***five*** from the rest

1. There is a hat stream Sh_1, in a chemical plant with an inlet temperature of 400^oC and heat capacity flow rate of 100 units to be cooled to 200^oC. In the same chemical plant, there are two more cold steams Sc_1 and Sc_2 with their inlet temperature as 100^oC and 200^oC respectively to be heated to 150^oC and 250^oC respectively. Heat capacity flow rates Sc_1 and Sc_2 are assumed to be 200 units each.

   Show different ways in which the task can be achieved. Show those with the help of diagrams.

   Show also that the order of contacting hot and cold streams is extreamly important. 6+10

2. a) State the deduction theorem of propositional logic and prove it.

   b) MgO, H_2, O_2 and C are raw materials and can perform the following reactions.

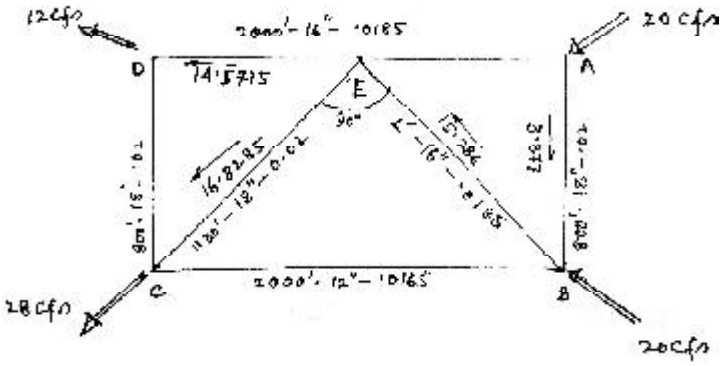
   $$MgO + H_2 \rightarrow Mg + H_2O$$

   $$C + O_2 \rightarrow CO_2$$

   $$CO_2 + H_2O \rightarrow H_2CO_3$$

Draw a flow sheet for the production of H_2CO_3 using deduction theorem of propositional logic. 4+12

3.



Water is flowing through network shown above. This network is to be analysed using Hardycross procedure. Length of the pipe in ft, inside diameter of the pipe in inch and fanning friction coefficient are shown against each pipe line in order. Length L is not known. Find the flowrate and pressure drop in each pipe line using Hardy Cross method (complete one iteration and find the corrected flow rate in each member. Use this corrected flowrate for pressure drop calculation). Initial guess of flow rate at some members are suggested in the figure. 20

4. Draw an optimal separation flowsheet to achieve goals G_1, G_2 & G_3, when two streams S_1, S_2 are available. The order of achieving the goal is G_2, G_1, G_3.

7. Write short notes on the following ***(any four)***

   i) Guide rule for estimating split fraction coefficients for absorption or stripping column.

   ii) FLOWTRAN

   iii) Manning equation for pipe friction.

   iv) Linearization method for analysis of pipe line network.

   v) Main constituent featues of full steady state simulation programs for computer aided flowsheeting. 45 4

Stream	X_A	X_B
S_1	3	7
S_2	7	3
G_1	2	0
G_2	2	7
G_3	6	3

Use Mortard rule.

5. Develop the material balance equations afterputting the split fraction coefficients. Show the equations in matrix form and write the first estimate of the split fraction coefficients with reasoning. (Fig(1) may be refered. The yield is 60% and conversion per pass is 80%. 16

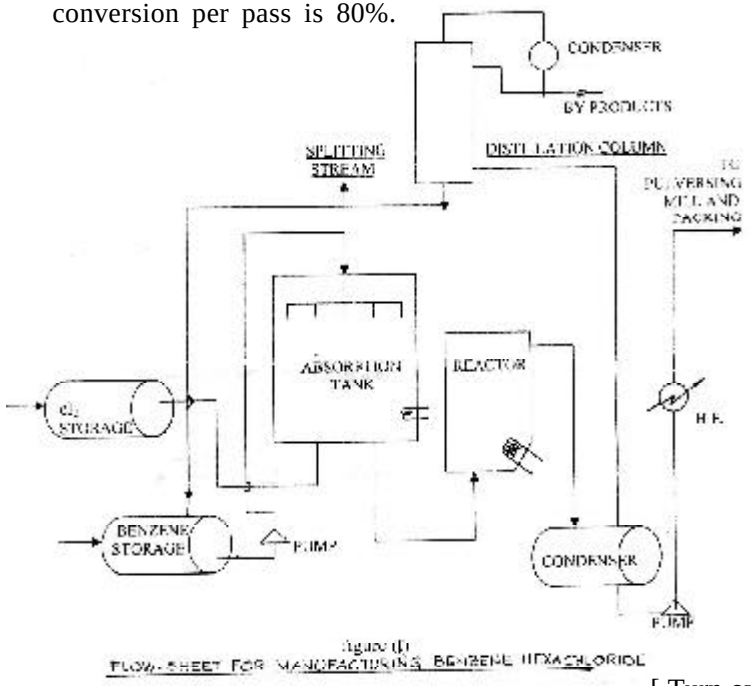


Figure (1)
FLOW SHEET FOR MANUFACTURING BENZENE HEXACHLORIDE

6. Rawmaterials and reaction list is given below and the goal G is a mixture of A_6 and B_7. Draw a steady state flow diagram for the purpose. 16

Raw mat.	Species (liq)	Temp °C	Press atm	Reaction	Input	Output	Temp, °C	Press atm
S_1	A_5, B_4	30	2		A_1, A_2	A_1, A_3, A_5	100	2
S_2	A_2, B_3	25	1		A_3, A_5	(i) A_6, A_3 (liquid)	90	1
						(ii) A_7, A_5 (gas)		
S_3	A_1, B_1, B_2	25	1					
S_4	A_8, A_9	30	1					
S_5	A_{11}, B_7	25	1		A_3, A_8	A_9, A_{16} (liquid)	50	1