Department of Chemical Engineering, Indian Institute of Technology Delhi
CHL 712: Computer Aided Design in Chemical Engineering
Semester II, 2007-2008

Closed Book & Notes **Major Examination**
Date: 28/04/08 **Time: 2 hr** **Marks: 35**

1. [10 Marks] Design a HEN to meet MER targets with ΔT_{min} = 10 ^{0}C for the following streams.

Stream	T^s (^{0}C)	T^t (^{0}C)	C (kW/^{0}C)
H1	180	40	2
H2	150	40	4
C1	60	180	3
C2	30	130	2.6

2. Answer the following in one or two sentences (descriptive answers will not be evaluated)
   a. [6 Marks] What is characteristic difference between P&ID and PFD. List the various distinct regions in a P&ID.
   b. [2 Marks] In shortcut distillation method, what does a negative value of $x_{i,D}$ imply?
   c. [2 Marks] In shortcut distillation method, what does a negative value of reflux ratio imply?
   d. [2 Mark] In separation of a ternary mixture by distillation, it is desired to obtain each of the three components as products. When is a single column with side-stream product likely to be the optimum design?
   e. [2 Marks] For what type of system (mixture) sum rate method for simulation of distillation recommended?
   f. [2 Marks] when is purge preferred over recycle.

3. [5 Marks] Find the key components for the following distillation column:

Component	CH_4 (1)	C_2H_6 (2)	n-C_3H_8 (3)	n-C_4H_{10} (4)	n-C_5H_{12} (5)	n-C_6H_{14} (6)
$x_{i,F}$	0.03	0.07	0.15	0.33	0.30	0.12
K (80 ^{0}C)	21	5.9	2.49	0.95	0.395	0.180

Feed: T = 82 ^{0}C, P = 1035 N/m^2; Vapor distillate to contain 98% of 3 but only 1 % of 5. Take column temperature = 80 ^{0}C and assnme ideal solution with K values at 80 ^{0}C given in Table above.

Shiras eqn: $$\frac{Dx_{i,D}}{Fx_{i,F}} = \frac{(\alpha_{i,hk})_F - 1}{(\alpha_{lk,hk})_F - 1}\frac{Dx_{lk,D}}{Fx_{lk,F}} + \left[\frac{(\alpha_{lk,hk})_F - (\alpha_{i,hk})_F}{(\alpha_{lk,hk})_F - 1}\frac{Dx_{hk,D}}{Fx_{hk,F}}\right]$$

4. [4 Marks] Derive the stream matching criterion at pinch point (both above pinch side and below pinch side).