E sem VIII CBSG Chem MSO 30-5-2016

Q.P. Code : 733901

(3 Hours)   [Total Marks : 80

N.B.: (1) Question **No.1** is **compulsory**.
   (2) Answer **any Three** out of remaining **Five** questions.
   (3) Assume suitable data wherever required and state them clearly.
   (4) **Figures** to the **right** indicate **full marks**.

1. Solve **any Four** :
   (a) Explain types of flow sheet simulation.
   (b) What are the assumptions to be made for simulation in ideal phase.
   (c) Explain methods to solve non linear equations.
   (d) List out various methods of optimization and explain in brief.
   (d) Write with specific applications, types of chemical process simulators.

2. Consider the separation of B. T. X, mixture in bubble point feed to distillation
   column, where 99% of B is to be recovered in the overhead and 99.5% of
   X is to be recovered in bottom stream. The bubble point feed is at temperature
   of 386 K and 1 bar pressure. Find out the composition of overhead and bottom
   streams, using data :

Component (k)	Flow rate in feed (k mole/hr)	Antone constant		
		Ak	Bk	Ck
Benzene	20	15.9008	2788.51	-52.34
Toluene	30	16.0137	3096.52	-53.67
Xylene	50	16.1156	3395.57	-59.44

3. (a) Solve graphically the following problem (Lagrange multiplier method)
   Maximize $Z = 2x_1 + 3x_2$
   Subject to :
   $$x_1^2 + x_2^2 \leq 20$$
   $$x_1 * x_2 \leq 8$$
   $$\& \quad x_1, x_2 \geq 0$$

   (b) Solve the following problem by Kuhn Tucker condition   10
   Max. $Z = 10x_1 + 4x_2 - 2x_1^2 - 3x_2^2$
   Subject to :
   $$2x_1 + x_2 \leq 5$$
   $$x_1, x_2 \geq 0$$

TURN OVER

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4. (a) Using Newton's method with an Armijo line search, solve the following 10 system of equation :
$$f_1 = 2x_1^2 + x_2^2 - 6 = 0$$
$$f_2 = x_1 + 2x_2 - 3.5 = 0$$

(b) Solve the fixed point problem given by :
$$x_1 = 1 - 0.5 \exp(0.7(1 - x_2) - 1)$$
$$x_2 = 2 - 0.3 \exp(0.5(x_1 + x_2))$$
Using direct substitution method starting from $x_1 = 0.8$ and $x_2 = 0.8$. Estimate the maximum eigen value.

5. (a) A flash unit operator at 1atm and 373 K. A liquid feed comprised of Methanol, Propanol and Acetone with an enthalpy of −264.6 kJ/mol enters the unit. No external heat is supplied. Determine the vapour traction (V/F) based on the following data. The coefficients to determine the specific heat in J/mol-k are given in table. The reference temperature is 298 K. The enthalpy of formation at standard state and the heat of vaporization at 373 K are given in kJ/mol. The vapour and liquid phase compositions are represented as mole fractions.

Component	Methanol	Propanol	Acetone
a	21.14	2.47	6.30
b	0.07	0.33	0.26
c	2.59×10^{-5}	-1.85×10^{-4}	-1.25×10^{-4}
d	-2.85×10^{-8}	4.29×10^{-8}	2.04×10^{-8}
H^0f	−239	−303	−248
Hvap	32.39	41.47	26.16
x	0.40	0.23	0.37
y	0.39	0.05	0.56

TURN OVER

6. Feed streams with pure species A and B are mixed with recycle stream enter 20 CSTR, where following reactions takes place :

$$A + B \rightarrow C$$
$$C + B \rightarrow P + E$$
$$P + C \rightarrow G$$
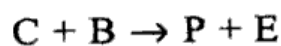
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Hear C is an intermediate, P is main product, E is bi product and G is oily waste. The plant consist of reactor, a heat exchanger to cool reactor effluent, a decanter to separate waste product G from reactants and other products and a distillation column to separate product P. Due to formation of an azoetrope some of product (equivalent to 10 wt% of mass flow rate of component E) is retained in the column bottom most of the bottom product is recycled to reactor and rest is purged. Construct a William otto flowsheet and davelop the process equation without energy balance.

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