Duration 03 Hr **Total Marks: 80**

N.B. 1) Question No.1 is compulsory
2) Answer any three out of five question
3) Assume suitable data wherever necessary and state them clearly
4) Figure to the right indicate full marks

Q.1

a) Explain in details Modular approach 05

b) Explain methods to solve non linear eqution 05

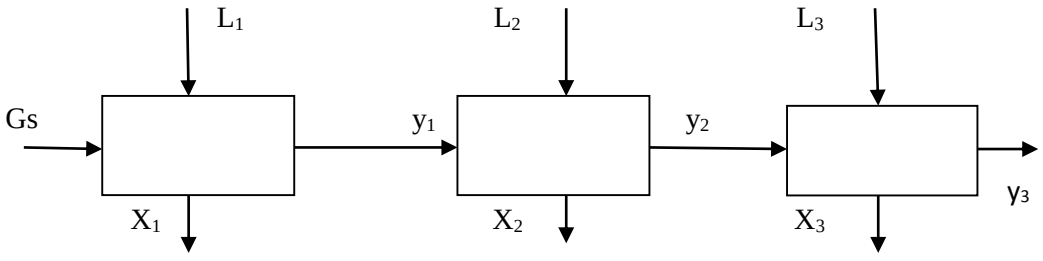
c) List out the various methods of optimization and explain in brief. 05

d) What are the assumption s to be made for simulation in ideal phase 05

Q2 A flash unit operates at 1 atm 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 fraction (V/F) based on the following data. The coefficients to determine the specific heat in J/(mol.K) are given in the table. The reference temperature is 298 K. The enthalpy of formation at standard state and the heat of vapourization at 373 K are given in kJ/mol. The vapour phase and liquid phase compositions are represented as mole fractions. 20

Component	Methanol	Propanol	Acetone
a	21.14	2.47	6.3
b	0.07	0.33	0.26
c	$2.59x10^{-05}$	$-1.85x10^{-04}$	$-1.25x10^{-4}$
d	$-2.85x10^{-8}$	$4.29x10^{-8}$	$2.04x10^{-08}$
H_f^0	-239	-303	-248
Hvap	32.39	41.47	26.16
x	0.40	0.23	0.37
y	0.39	0.05	0.56

Q.3 A proposed new method for desalting brackish water is as follows: 20



The salt is to be absorbed on to a patented solid adsorbent in a three stage process as shown above. Determine the distribution of pure adsorbent so as to minimize the total flow rate required. The equilibrium relation is given by $y= x^2/100$

Gs= 1000 kg/hr of water

X= Kg of salt per kg of adsorbent

y= Kg of salt per Kg of water

y_0=0.03 and y_3=0.0001

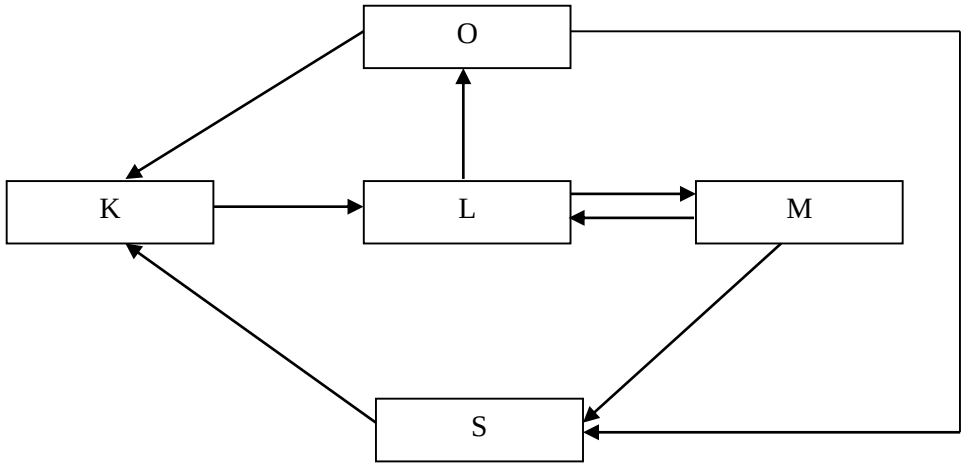
Use Newtons method and show at least two iterations

Q.4(a) In a absorption column vapour consist of 10 mol/s air and 01 mol/sec acetone . Acetone is to be absorbed in water(solvent) Solvent temperature is of 300K and pressure of 10 bar .Recovery of acetone r=0.95. Absorption factor 1.4.Calculate required water flow rate, No.of stages and flow rates of existing stream 10

Antonie Constant **Water** A= 8.07131 B= 1730.63 C= 233.426

Acetone A=4.42448 B=1312.253 C= -32.445

Q.4(b) Find the tear stream for the given flowsheet 10



Q.5 Feed streams with pure species A and B are mixed with a recycle stream in a CSTR, where the following reactions take place: 20

$A + B \rightarrow C + D$

$A + C \rightarrow 2E$

$B + E \rightarrow F$

F is a gaseous product, D is a solid waste, C is a by-product while E is the main product. The plant consists of a reactor, a filter and two distillation columns. 98% of high boiling E is recovered from the first column, while volatile C is separated in the

second column. Due to formation of an azeotrope, some of component C (equivalent to 10 wt% of component E) is retained in the column bottoms. 90% of this bottom product is recycled, while the rest is purged. Construct a Williams-Otto flowsheet and develop the process equations.

Q6(a)) Solve by Lagrangian Method 10

$S=2X_1X_2+2X_2X_3+X_1X_3$

$X_1X_2X_3=32$, &$X_1,X_2,X_3>0$

Q6(b) Solve graphically the following problem: 10

Maximize $Z = 2x_1 + 3x_2$

subject to $x_1^2 + x_2^2 = 20$,

$x_1x_2 < 8$ and $x_1, x_2 > 0$

_____