BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

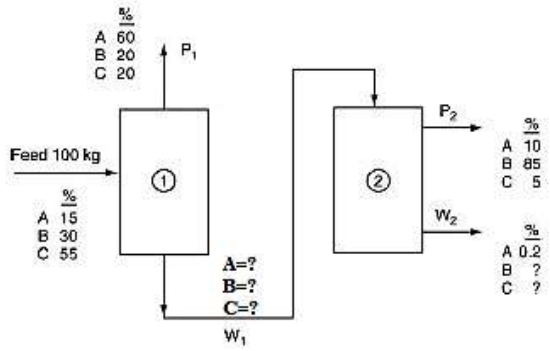
CLASS: BE **SEMESTER: V**
BRANCH: CHEM. ENGG. **SESSION : MO/2018**

SUBJECT : CL5007 COMPUTER AIDED PROCESS ENGINEERING

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) In figure below, steady state operation of two successive liquid separation columns (and with no reaction taking place) is presented. Write down the all independent material balance equations for the system with degree of freedom analysis. [2]



(b) Briefly formulate suitable numerical method for the solution of the above-mentioned unit, with initial guess and convergence. [3]

Q2 (a) A catalytic reactor undergoes following reversible reactions at 977°C and 1 atm pressure from 100 mol of ethane C_2H_6 feed: 1) $C_2H_6 \Leftrightarrow C_2H_4 + H_2$; 2) $C_2H_6 \Leftrightarrow C_2H_2 + 2H_2$. The reactions obey following chemical reaction equilibria: $\frac{Y_{C_2H_4}Y_{H_2}}{Y_{C_2H_6}} = 3.75$; $\frac{Y_{C_2H_2}Y_{H_2}^2}{Y_{C_2H_6}} = 0.135$. Find out extent of reactions ζ_1 and ζ_2 of 1) and 2) reactions, respectively. [4]

(b) Write the Matlab solver function with a routine to solve the system above. [1]

Q3 Water is pumped between two reservoirs (*A* and *B*) in a single pipe with the value of R=100 s^2/m^5. Pump characteristics curve is given by H_P=20+10Q−100Q^2. Compute the discharge Q and pump head H_p for H_B−H_A=20. Where, H_B and H_A are height of reservoir *B* and *A*, respectively from a reference plane. Assume the top reservoir is closely connected to the supply pipe. [5]

Q4 Write algorithm to solve dew point temperature of a vapor mixture contains 50% pentane (1), 30% hexane (2) and 20% cyclohexane (3) (all in mol-%) at 5 bar pressure. [5]
Where, $log_{10}P_{sat}(bar) = A - \frac{B}{T(K)+C}$. Assume ideal mixtures.

Components	A	B	C
pentane	3.97786	1064.840	−41.136
hexane	4.00139	1170.875	−48.833
cyclohexane	3.93002	1182.774	−52.532

PTO

Q5 (a) Derive Rachford-Rice flash equation for flashing of ternary liquid mixture. [2]

(b) Write different types of method for computing activity coefficient of nonideal liquid mixture with their parameter and valid molecules. [3]

Q6 For a mixture (100 mol) of propane, n-butane, n-pentene, and n-octane, phase equilibrium K-values and inlet compositions $\{z_i\}$ are given in the table below. Write the method of constructing EXCEL Goal Seek function to compute vapor split V/F and consequently, vapor $\{y_i\}$ and liquid $\{x_i\}$ phase compositions, vapor product V and liquid product L in a flash chamber using Rachford–Rice equation. Use following table: [5]

Components, i	$\{z_i\}$	Phase Equilibrium K-value
propane	0.1	6.8
n-butane	0.3	2.2
n-pentene	0.4	0.8
n-octane	0.2	0.052

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