CLASS: BE   SEMESTER: V
BRANCH: BIOTECHNOLOGY   SESSION : MO/2019

SUBJECT : BT5023 CHEMICAL ENGINEERING III

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   100 kmol of a mixture (A and B) is fed to a simple still. The feed contains 50 mol% of A   [5]
       and a remain in the still is 5 mol% of A. Calculate the quantity and the average
       composition of the product obtained? The equilibrium data are

x	1.0	0.9	0.6	0.5	0.4	0.3	0.2	0.1	0.05
y	1.0	0.932	0.745	0.67	0.57	0.46	0.34	0.2	0.1

Q2   A liquid mixture containing 40 mol% of n-heptane and 60 mol% of n-octane is to be   [5]
       continuously flash vaporized at 1 atm. The product vapour is 70% of the feed. What will
       be the composition of the vapour and liquid. Given $\alpha_{AB} = 2.16$

Q3   A continuous rectifying column handles a mixture consisting of 40 per cent of benzene by   [5]
       mass and 60 per cent of toluene at the rate of 4 kg/s, and separates it into a product
       containing 97 per cent of benzene and a liquid containing 98 per cent toluene. The feed
       is liquid at its boiling-point. (a) Calculate the mass flows of distillate and waste liquor.
       (b) If a reflux ratio of 3.5 is employed, how many plates are required in the rectifying
       part of the column?

Mole fraction of benzene in liquid	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Mole fraction of benzene in vapour	0.22	0.38	0.51	0.63	0.7	0.78	0.85	0.91	0.96

Q4   A mixture of benzene and toluene containing 40 mole % of benzene is to be separated to   [5]
       give a product of 90 mole % of benzene at the top and bottom product with not more
       than 10 mole % of benzene. Using an average value of 2.4 for the volatility of benzene
       relative to toluene, calculate the number of theoretical plates required at total reflux.

Q5   1000 kg/h of a mixed hydrocarbon feed containing 27.00% toluene by mass is processed   [5]
       using liquid-liquid extraction to remove most of the toluene. This is done by bringing it
       into contact with 2000 kg/h of an immiscible solvent containing 1.00% toluene by mass.
       The raffinate contains 4.00% and the extract 11.59% toluene by mass. Calculate the mass
       flowrates of the extract and raffinate.

Q6   A liquid containing 47.5% acetic acid and 52.5% water is to be separated by solvent   [5]
       extraction using isopropanol. The solvent used is 1.3 kg per kg of feed. The final extract
       is found to contain 82% acid on solvent free basis. The residue has 14% acid on solvent
       free basis. Find the percentage extraction of acid from the feed.