$A \rightleftharpoons R$

starting with pure A, kinetic experiments in a batch reactor give 58.1% conversion

REG.NO.: 23BCM0052

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF CHEMICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST -II
FALL SEMESTER 2025-2026

SLOT: A 1+TA1

Programme Name & Branch	:	B.Tech Chemical Engineering
Course Code	:	BCHE302L
Course Name	:	Mass transfer-II
Faculty Name(s)	:	Dr.G.S.Nirmala
Class Number(s)	:	VL2025260101234
Date of Examination	:	05-09-25
Exam Duration	:	90 minutes Maximum Marks: 50

General instruction(s):

- Graph sheets will be provided
- Assume any missing data

Q. No	Question	Marks	CO	BL
1.	Hydrogen Sulfide (H_2S) is a colourless, flammable and hazardous gas found in many refinery streams. It is heavier than air and can travel along the ground. A level of H_2S gas above a certain ppm is Dangerous to Life and Health, Hence as a process engineer working in a refinery gas unit calculate the height of the absorber used if the entire resistance to mass transfer lies in the gas phase for the **given condition**: Gas from petroleum refinery has its concentration of H_2S reduced from 0.03($kmolH_2S$/Kmol inert gas) to 1% of these value by scrubbing with a solvent in a counter-current tower at 27 °C and 1 atm. The equilibrium relation is Y*=2X, where X and Y* are in mole ratios. The solvent enters free of H_2S and leaves at a concentration of 0.013 $kmolH_2S$/kmol of solvent. The flow rate of incoming gas is 55.6kmol/h.m^2 of tower cross-section and the gas phase resistance controls the process Assume K_ya=0.04 kmol/(m^3 of tower volume .S . Δy)	10	2	4
2.	An absorption column is to be designed for reducing the concentration of a toxic vapour in an air emission from 1% to 0.02 mole%. The column will operate at 20°C and 0.5 bar gauge pressure. The scrubbing liquour flow rate is 1.3 times the minimum. The gas liquid equilibrium relation (p=Hx) is linear and the Henrys law constant is 10 bar. How many trays are required to chieve this separation. Hint: Calculate L/G ratio and determine Absorption factor to apply it in Kremser equation.	10	3	4
3.	500 kg of an aqueous feed containing 50 mass% acetic acid is contacted with a solvent containing 98%benzene and 2%acetic acid. The mass ratio of the feed to solvent is 1.1. Calculate the mass and composition of the	10	3	4

extract and the fraction of acetic acid in the feed extracted in a single stage cross current extraction. The operation is carried out at 25°C and the equilibrium and tie line data are given below

Aqueous phase (mass fraction)			Benzene phase (mass fraction)		
Water	Benzene B	Acetic acid C	Water	Benzene B	Acetic acid C
0.8297	0.0123	0.158	0.013	0.70	0.287
0.7311	0.0129	0.256	0.022	0.557	0.421
0.6229	0.0171	0.36	0.044	0.429	0.527
0.456	0.051	0.493	0.103	0.284	0.613
0.345	0.098	0.557	0.186	0.204	0.61

4.	a. Give the difference between distillation and extraction. Can two tie lines intersect within the two-phase region of an LLE diagram? Explain *qualitatively*.	5	4	3
	b. In liquid-liquid equilibrium studies, a system is called Type-II if ----------	5		
	c. What causes a Type -II liquid-liquid system to become a Type I system?			
	Acetone is to be recovered from an aqueous solution containing 20% acetone by using kerosene as a solvent. The distribution of acetone in water and kerosene follows the relationship X=6.45Y, where X=Kg of acetone/kg of water, Y=Kg acetone/kg of kerosene. If the extraction is done by counter-current using 6kg of kerosene per kg of aqueous solution of acetone in a tower, determine the number of equivalent theoretical step necessary to reduce the concentration from 0.20 to 0.40 in the aqueous flow. Assume that the kerosene and water are nearly immiseible with each other. All compositions are in a weight basis.	10	2	4

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