


Name:			
Enrolment No:			
<b>UPES</b> <b>End Semester Examination, May 2025</b>			
<b>Programme Name : B.Tech Chemical Engineering</b>		<b>Semester : IV</b>	
<b>Course Name : Mass Transfer</b>		<b>Time : 03 hrs</b>	
<b>Course Code : CHCE2034</b>		<b>Max. Marks: 100</b>	
<b>Nos. of page(s) : 02</b>			
<b>Instructions: In case of data missing make necessary assumptions</b>			
<b>S. No.</b>	<b>SECTION A</b> <b>(4*5 Marks=20 Marks) Answer all questions</b>	<b>Marks</b>	<b>CO</b>
Q 1	Define mass average velocity and molar average velocity	5M	CO1
Q 2	Define flooding and coning.	5M	CO1
Q 3	Differentiate between azeotropic and extractive distillation.	5M	CO1
Q 4	List out the characteristics of the packing materials used for absorption.	5M	CO1
	<b>SECTION B</b> <b>(4*10 Marks=40 Marks) Answer all questions</b>		
Q5	A gas mixture ( $N_2=6\%$ , $H_2=25\%$ , $NH_3=66\%$ , and $Ar=3\%$ ) flows through a pipe, 25.4 mm in diameter, at 4.05 bar total pressure. If the velocities of the respective components are 0.03 m/s, 0.035 m/s, 0.03 m/s, and 0.02 m/s. Calculate the mass average and molar average velocities of the mixture.	10 M	CO2
Q 6	Explain the step-by-step procedure for finding the number of stages for steady-state cross-current contact.	10 M	CO3
Q 7	Describe the criteria for selecting a suitable solid-liquid extraction system for industrial applications.	10 M	CO2
Q 8	In a graph, draw the equilibrium and operating lines for counter-current stripping and absorption with the help of material balance expressions.	10 M	CO2
	<b>SECTION C</b> <b>(2*20 Marks=40 Marks) Attempt all questions</b>		
Q 9	A mixture of benzene and toluene containing 35 mole% of benzene is to be separated to give a product of 90 mole% benzene at the top, and the bottom product with 5 mole% benzene. The feed enters the column at its boiling point, and the vapor leaving the column is simply condensed and provides product and reflux. It is proposed to operate the unit with a reflux ratio of 3.0. Locate the feed plate and the number of plates. The vapor pressures of	20 M	CO3

	pure benzene and toluene are 1460 and 584 mm Hg, respectively. Total pressure is 750 mm Hg.																																																																				
Q10	<p>If 200 kg of a solution of acetic acid (C) and water (A) containing 30% acid is to be extracted two times with isopropyl ether (B) at 20 °C, using 50 kg of solvent in each stage, determine the quantities and compositions of the various streams.</p> <p>Equilibrium Data:</p> <table><tr><th colspan="3">Water layer (100 kg)</th><th colspan="3">Isopropyl ether layer (100 kg)</th></tr><tr><th>Acetic acid</th><th>Water</th><th>Isopropyl ether</th><th>Acetic acid</th><th>Water</th><th>Isopropyl ether</th></tr><tr><td>0.69</td><td>98.1</td><td>1.2</td><td>0.18</td><td>0.5</td><td>99.3</td></tr><tr><td>1.41</td><td>97.1</td><td>1.5</td><td>0.37</td><td>0.7</td><td>98.9</td></tr><tr><td>2.89</td><td>95.5</td><td>1.6</td><td>0.79</td><td>0.8</td><td>98.4</td></tr><tr><td>6.42</td><td>91.7</td><td>1.9</td><td>1.93</td><td>1.0</td><td>97.1</td></tr><tr><td>13.30</td><td>84.4</td><td>2.3</td><td>4.82</td><td>1.9</td><td>93.3</td></tr><tr><td>25.50</td><td>71.1</td><td>3.4</td><td>11.40</td><td>3.9</td><td>84.7</td></tr><tr><td>36.70</td><td>58.9</td><td>4.4</td><td>21.60</td><td>6.9</td><td>71.5</td></tr><tr><td>44.30</td><td>45.1</td><td>10.6</td><td>31.10</td><td>10.8</td><td>58.1</td></tr><tr><td>46.40</td><td>37.1</td><td>16.5</td><td>36.20</td><td>15.1</td><td>48.7</td></tr></table>	Water layer (100 kg)			Isopropyl ether layer (100 kg)			Acetic acid	Water	Isopropyl ether	Acetic acid	Water	Isopropyl ether	0.69	98.1	1.2	0.18	0.5	99.3	1.41	97.1	1.5	0.37	0.7	98.9	2.89	95.5	1.6	0.79	0.8	98.4	6.42	91.7	1.9	1.93	1.0	97.1	13.30	84.4	2.3	4.82	1.9	93.3	25.50	71.1	3.4	11.40	3.9	84.7	36.70	58.9	4.4	21.60	6.9	71.5	44.30	45.1	10.6	31.10	10.8	58.1	46.40	37.1	16.5	36.20	15.1	48.7	20 M	CO4
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