U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 22CH5PCMT2 **Max Marks: 100**
Course: Mass Transfer - II

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			CO	PO	Marks
		UNIT - I			
1	a)	Classify the gas-liquid contacting equipment. Enlist the equipment of each class.	CO2	PO3	4
	b)	With the aid of their expressions, define Point tray efficiency, Murphree tray efficiency and overall tray efficiency.	CO3	PO4	6
	c)	Draw a comparison of the operational characteristics of tray and packed columns for gas-liquid contact operations.	CO3	PO4	10
		OR			
2	a)	Enlist the criteria for choice of solvent in a gas absorption process.	CO4	PO2	10
	b)	NH_3 is to be removed from a mixture of 20% NH_3 and 80% air by counter-current scrubbing with water at 1 atm. and 20 ^{0}C. Evaluate the minimum solvent rate if 99% of NH_3 is to be removed and also the theoretical stages for actual absorption with 1.2 times the minimum solvent rate. The rate of flow of the mixture is 3500 Kg/h.	CO3	PO4	10

Partial pressure of NH_3, mm Hg	**12**	**18**	**32**	**50**	**70**	**166**
g NH_3/ 10 g H_2O	**0.2**	**0.3**	**0.5**	**0.75**	**1**	**2**

		UNIT - II			
3	a)	With the help of a schematic diagram, illustrate the process of simple distillation. Derive the Rayleigh's equation for simple distillation. Mention the significance of the Rayleigh's equation.	CO3	PO4	10
	b)	A continuous fractionating column operates with the reflux ratio of 3.5 to separate 13,600 kg/h of a mixture of 40 wt. % benzene and the rest toluene to get a distillate containing 97 wt. % benzene and residue containing 98 wt. % toluene. If feed is at its boiling point, determine the following: i. Rate of distillate and residue ii. Number of ideal trays required	CO3	PO4	10

<table>
<tr><td></td><td></td><td></td><td>iii. Position of the feed tray
Data:
<table><tr><td>Mole fraction of benzene in liquid</td><td>0.1</td><td>0.2</td><td>0.3</td><td>0.4</td><td>0.5</td><td>0.6</td><td>0.7</td><td>0.8</td><td>0.9</td></tr><tr><td>Mole fraction of benzene in vapor</td><td>0.21</td><td>0.35</td><td>0.51</td><td>0.64</td><td>0.72</td><td>0.79</td><td>0.86</td><td>0.91</td><td>0.96</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>a)</td><td>What azeotropes do the mixtures that exhibit positive deviations from ideality form? Explain with the aid of T-x-y, P-x-y and x-y diagrams.</td><td>CO1</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>With the help of a schematic diagram, operating line on a x-y diagram, and relevant derivation, demonstrate the process of flash vaporization.</td><td>CO3</td><td>PO4</td><td>10</td></tr>
<tr><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>a)</td><td>With the neat flow diagram of a specific industrial application, demonstrate the process of Azeotropic Distillation.</td><td>CO4</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>With the help of relevant derivation, demonstrate the step-by-step graphical procedure of Ponchon- Savarit method to find the number of theoretical plates required for distillation.</td><td>CO3</td><td>PO4</td><td>10</td></tr>
<tr><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>a)</td><td>Enlist any four industrial applications of liquid-liquid extraction and solid-liquid leaching processes.</td><td>CO4</td><td>PO2</td><td>4</td></tr>
<tr><td></td><td>b)</td><td>A 20 wt.% vegetable oil in water mixture at 150kg/h is to be extracted using hexane in a three-stage cross flow extraction system with 120 kg/h of hexane containing 2 wt.% vegetable oil being used in each stage. Determine the final content of vegetable oil in water. The miscibility of hexane in water may be neglected. The solubility data of vegetable oil in water and hexane is given below:
<table><tr><td>Wt.% vegetable oil in water</td><td>2.8</td><td>5.1</td><td>18.9</td><td>25.2</td><td>33.06</td></tr><tr><td>Wt.% vegetable oil in hexane</td><td>3.1</td><td>5.23</td><td>22.49</td><td>32.03</td><td>46.345</td></tr></table></td><td>CO3</td><td>PO4</td><td>10</td></tr>
<tr><td></td><td>c)</td><td>With the help of a schematic diagram, explain the construction and working of a rotating disc contactor.</td><td>CO2</td><td>PO3</td><td>6</td></tr>
<tr><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>a)</td><td>Elucidate in detail about the typical phase diagrams of solid-liquid leaching process with neatly labeled the diagrams.</td><td>CO3</td><td>PO4</td><td>10</td></tr>
<tr><td></td><td>b)</td><td>With the help of a schematic diagram, relevant derivation and N-x-y* diagram, explain multi-stage cross-current solid-liquid leaching process. Comment on the percentage extraction achieved by the process.</td><td>CO3</td><td>PO4</td><td>10</td></tr>
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