Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

V SEMESTER B.TECH. (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2016

SUBJECT: MASS TRANSFER-II [CHE 309]

REVISED CREDIT SYSTEM
(03/12/2016)

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A. 100 kmol/hr of feed having 65 mole % of benzene (A) and toluene (B) is flash vaporized at 1 atm. Calculate the composition of residue α is constant at 2.2 ; Data : H_F= 4000 kJ/kmol Q=1000 MJ/kmol/hr, H_D= 20000 KJ/kmol and H_W= 7000 kJ/kmol — 7

1B. Calculate the bubble and dew point of the solution and its composition at 3 atm. Log (P)= A-(B/(C+T)) P is mm Hg, T ^{0}C — 10

Component	composition	A	B	C
n-Pentane (A)	0.3	6.87632	1075.78	233.205
n-Hexane (B)	0.5	6.91058	1189.64	226.28
n-Octane (C)	0.2	6.89386	1264.37	216.64

1C. Briefly explain the steam distillation — 3

2. A dilute aq. solution of Ethanol is to be concentrated from 30% to 80% in a tray tower at atmospheric pressure. The feed rate is 200 Kmoles/hr with an enthalpy of 20000 KJ/Kmol. The bottom product must not contain more than 3.5 % Ethanol (all are in mole %). Determine Minimum reflux ratio and Calculate the condenser and reboiler heat loads at minimum reflux ratio for the partial condenser.
The enthalpy and concentration and equilibrium data (mole %) are given below H is in KJ/kmol, x,y are in mole %. — 20

x,y	0	0.0891	0.207	0.37	0.477	0.779	1
H_L	7540	6880	7097	7750	8105	8945	9523
H_V	48150	48300	48436	48450	48631	48950	48990

X	0	0.016	0.020	0.0891	0.143	0.281	0.477	0.7	0.89
Y	0	0.158	0.191	0.427	0.493	0.568	0.644	0.756	0.89

3A. Briefly explain the following i) Extractive distillation ii) Azeotropic distillation with examples — 6

3B. Briefly describe the atleast four important properties required for good solvent in LLE — 6

3C. Derive the operating line equation of absorption section in McCabe Thiele method — 8

<table>
<tr><td>4.</td><td>A solution is continuously and counter-currently extracted at the rate of 2.5 kg/s (Feed contains 50% water (A), 48% pyridine (C) and 2% chlorobenzene (B)) with chlorobenzene (contains 2% pyridine) to reduce the pyridine concentration to 5%. (Triangular coordinates)
i) Determine the minimum solvent rate required for this separation.
ii) Determine the minimum solvent rate for half the feed rate (F=1.25 kg/s)
<table>
<tr><th>Pyridine</th><th>Chloro-benzene</th><th>Water</th><th></th><th>Pyridine</th><th>Chloro-benzene</th><th>water</th></tr>
<tr><td>0</td><td>99.95</td><td>0.05</td><td></td><td>0</td><td>0.08</td><td>99.92</td></tr>
<tr><td>11.05</td><td>88.28</td><td>0.67</td><td></td><td>5.02</td><td>0.16</td><td>94.82</td></tr>
<tr><td>24.1</td><td>74.28</td><td>1.62</td><td></td><td>18.9</td><td>0.38</td><td>80.72</td></tr>
<tr><td>28.6</td><td>69.15</td><td>2.25</td><td></td><td>25.5</td><td>0.58</td><td>73.92</td></tr>
<tr><td>35.05</td><td>61</td><td>3.95</td><td></td><td>44.95</td><td>4.18</td><td>50.87</td></tr>
<tr><td>40.6</td><td>53</td><td>6.4</td><td></td><td>53.2</td><td>8.9</td><td>37.9</td></tr>
<tr><td>49</td><td>37.8</td><td>13.2</td><td></td><td>49</td><td>37.8</td><td>13.2</td></tr>
</table></td><td>20</td></tr>
<tr><td>5A.</td><td>Explain the types of modules used in membrane separations? (atleast three)</td><td>6</td></tr>
<tr><td>5B.</td><td>Explain various types of equilibrium diagrams encounter in Leaching with diagram

Explain the effect of temperature on leaching (atleast two important points)</td><td>6

2</td></tr>
<tr><td>5C.</td><td>Give the component and complete balance in Leaching (all three components)</td><td>6</td></tr>
<tr><td>6A</td><td>Briefly explain the system of two liquids and ne solid with example in LLE</td><td>3</td></tr>
<tr><td>6B</td><td>A solution is prepared by dissolving 35.0 g of haemoglobin in enough water to make up 1.00 L in volume. The osmotic pressure of the solution is found to be 10.0 mmHg at 25.0 °C. Calculate the molar mass of haemoglobin.

Explain briefly osmotic pressure, retentate, permeate, flux, retention factor, transmembrane pressure</td><td>5

5</td></tr>
<tr><td>6C.</td><td>Give complete mole, component, energy balance equations of continuous distillation column with partial condenser

State Raoults law and prove that $\alpha_{AB}= P_A/P_B$, where α_{AB}=is relative volatility and P_A, P_B are saturated vapor pressure of A and B (Where A is more volatile component)</td><td>3

4</td></tr>
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