| Reg. No. | | | | | | | | | | |
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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

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## V SEMESTER B.TECH. ONLINE PROCTORED END SEMESTER EXAMINATIONS DEC 2021

SUBJECT: MASS TRANSFER II [CHE 3152]

**REVISED CREDIT SYSTEM**
**(23/12/2021)**

Time: 75 minutes MAX. MARKS: 20

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

| | | |
|---|---|---|
| **1A.** | A solution of carbon tetrachloride and carbon disulfide containing 50 wt% each is to be continuously fractionated at standard atmospheric pressure at the rate of 5500kg/h. The distillate product is to contain 92 wt % carbon disulfide, the residue 0.8 wt %. The feed will be 40 mol% vaporized before it enters the tower. A total condenser will be used, and the reflux will be returned at the bubble point. The equilibrium data (x,y* = mole fraction $CS_2$) is as follows:<br><br>Molecular weight of carbon disulfide and carbon tetrachloride are 76 g/mol and 154 g/mol respectively.<br><br>T (°C) \| x \| y*<br>76.7 \| 0 \| 0<br>74.9 \| 0.0296 \| 0.0823<br>73.1 \| 0.0615 \| 0.1555<br>70.3 \| 0.1106 \| 0.2660<br>68.6 \| 0.1435 \| 0.3325<br>63.8 \| 0.2585 \| 0.4950<br>59.3 \| 0.3908 \| 0.6340<br>55.3 \| 0.5318 \| 0.7470<br>52.3 \| 0.6630 \| 0.8290<br>50.4 \| 0.7574 \| 0.8780<br>48.5 \| 0.8604 \| 0.9320<br>46.3 \| 1 \| 1<br><br>Determine the number of theoretical trays required at a reflux ratio equal to the twice the minimum. | **05** |
| **1B.** | Dilute ethanol-water solutions can be continuously rectified to give at best the mixtures containing 89.4 mole % ethanol at atmospheric pressure, since this is the composition of minimum boiling azeotrope in the binary system. Ethanol can be further purified either by using n-pentane as entrainer or ethylene glycol as solvent. Write short notes on the methods which uses the above-mentioned compounds in the purification of ethanol and comment on the most desirable method. | **02** |

**1C.** Discuss about spiral wound membranes and bundle of hollow fibers with schematic representation. Also, which among these is generally used in RO systems **03**

**2A.** 900 kg of crushed oil seeds (22% oil, 78% meal) is extracted in a three-stage cross-current unit using 600 kg of pure hexane in each stage. The equilibrium data are as follows: **05**

| **Overflow (100 kg) solution** | | | **Underflow (100 kg) slurry** | | |
|---|---|---|---|---|---|
| **$W_A$ (kg)** | **$W_B$ (kg)** | **$W_C$ (kg)** | **$W'_A$ (kg)** | **$W'_B$ (kg)** | **$W'_C$ (kg)** |
| 0.3 | 99.7 | 0 | 67.2 | 32.8 | 0 |
| 0.45 | 90.6 | 8.95 | 67.1 | 29.94 | 2.96 |
| 0.54 | 84.54 | 14.92 | 66.93 | 28.11 | 4.96 |
| 0.70 | 74.47 | 24.83 | 66.58 | 25.06 | 8.36 |
| 0.77 | 69.46 | 29.77 | 66.26 | 23.62 | 10.12 |
| 0.91 | 60.44 | 38.65 | 65.75 | 20.9 | 13.35 |
| 0.99 | 54.45 | 44.56 | 65.33 | 19.07 | 15.6 |
| 1.19 | 44.46 | 54.35 | 64.39 | 16.02 | 19.59 |
| 1.28 | 38.50 | 60.22 | 63.77 | 14.13 | 22.10 |
| 1.28 | 34.55 | 64.17 | 63.23 | 12.87 | 23.90 |
| 1.48 | 24.63 | 73.89 | 61.54 | 9.61 | 28.85 |

Calculate the fraction of oil extracted in a three-stage cross-current unit using PS method.

**2B.** Consider question 2A. Calculate the fraction of oil extracted in a single stage contactor for the same volume (1800kg) of the solvent and comment on the result. **03**

**2C.** Write a short note on any one solid-liquid contacting equipment which does not result in the clogging by fines with neat schematic diagram. **02**

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