

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-V (NEW) EXAMINATION – WINTER 2020****Subject Code:3150501****Date:27/01/2021****Subject Name:Mass Transfer Operations I****Time:10:30 AM TO 12:30 PM****Total Marks: 56****Instructions:**

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1**
- | | | |
|-----|---|-----------|
| (a) | Discuss the factors affecting choice of separation method. | 03 |
| (b) | Differentiate between packed towers/tray towers. | 04 |
| (c) | Discuss in detail classification of mass transfer operations with examples. | 07 |
- Q.2**
- | | | |
|-----|--|-----------|
| (a) | Explain mass transfer operation between two immiscible phases. | 03 |
| (b) | Explain material balance for single stage leaching. | 04 |
| (c) | Methane diffuses at steady state through a tube containing helium for the case equimolar counter diffusion. At point 1, the partial pressure of methane is 55 kPa and at point 2, 0.03 m apart is 15 kPa. The total pressure is 101.325 kPa and temperature is 298 K, at this temperature and pressure the value of diffusivity is $6.75 \times 10^{-5} \text{ m}^2/\text{s}$. Calculate the partial pressure of methane at point 0.02 m apart from point 1 for the above case. | 07 |
- Q.3**
- | | | |
|-----|---|-----------|
| (a) | Define selectivity, absorption factor and ideal stage. | 03 |
| (b) | Explain mass, heat and momentum transfer analogies. | 04 |
| (c) | Explain the following terms with respect to tray towers:
(i) Flooding (ii) Priming (iii) Coning (iv) Weeping (v) Dumping
(vi) Tray Spacing (vii) Theoretical Tray | 07 |
- Q.4**
- | | | |
|-----|---|-----------|
| (a) | Differentiate between random and regular packing. | 03 |
| (b) | Define liquid extraction giving typical example. Explain equilateral-triangular co-ordinate and the mixture rule. | 04 |
| (c) | Explain selection criteria for choice of solvent for gas absorption. | 07 |
- Q.5**
- | | | |
|-----|---|-----------|
| (a) | With neat diagram discuss Venturi Scrubber. | 03 |
| (b) | Discuss local and overall mass transfer coefficients. | 04 |
| (c) | Derive equations to calculate rate of steady state diffusion of 'A' through non-diffusing 'B' and also for steady state equimolar counter diffusion in case of gases. | 07 |
- Q.6**
- | | | |
|-----|---|-----------|
| (a) | Explain counter current multiple contact, Shanks system for leaching. | 03 |
| (b) | Discuss in detail about Film theory for mass transfer coefficient. | 04 |
| (c) | Enlist different industrial liquid extractors and explain any one in detail with neat figure. | 07 |
- Q.7**
- | | | |
|-----|---|-----------|
| (a) | Explain preparation of solids for leaching. | 03 |
| (b) | Discuss agitated batch crystallizer with neat sketch. | 04 |

- (c) A hot solution containing 2000 kg of MgSO_4 and water at 57°C and with a concentration of 30 weight% MgSO_4 is cooled to 30°C and $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ crystals are removed. The solubility at 30°C is 35.5 kg MgSO_4 per 100 kg water. Calculate the yield of crystals and % yield of crystallization. Assume that no water is vaporized. Atomic weight: $\text{Mg}=24$, $\text{S}=32$, $\text{O}=16$, $\text{H}=1$ **07**
- Q.8** (a) Explain caking of crystals and methods to prevent it. **03**
- (b) Define super saturation and explain Meir's super saturation theory. Explain stages of crystallization. Explain stages or mechanism of crystallization. **04**
- (c) Discuss the system of three liquids- one pair partially soluble and the effect of temperature on ternary equilibria. **07**

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