Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2018

Subject Code:2150501 **Date:27/11/2018**

Subject Name:Mass Transfer Operation - I

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Give the statement of McCabe 'ΔL law' for crystal growth?	**03**
	(b)	What is leaching? Write the Application of leaching	**04**
	(c)	Give the classification of mass transfer operation and explain with example.	**07**
Q.2	**(a)**	Define molecular and eddy diffusion.	**03**
	(b)	Define diffusion coefficient. How it varies with temperature and pressure.	**04**
	(c)	A volatile organic compound (C_6H_6) costing Rs. 5 a kg is stored in a tank 10 m diameter and open at the top. A stagnant air film 10 mm thick is covering the surface of the compound beyond which the compound is absent. If the atmospheric temperature is 25 ^{0}C, vapor pressure of compound 150 mm Hg and its molar diffusivity 0.02 m^2/ hr, calculate the loss in Rs/ day.	**07**
		OR	
	(c)	Calculate the rate of diffusion of water vapour from a thin layer of water at the bottom of a well 6 m in depth to dry air flowing over the top of the well. Assume the entire system is at 298 K & atmospheric pressure. If the well diameter is 3 m, fine out the total weight of water diffused per second from the surface of the water in the well. The diffusion coefficient of water vapour in dry air at 298 K & atmospheric pressure is 0.256×10^{-4} m^2/s. The partial pressure of water vapour at 298 K & is 0.0323×10^4 kg/m^2.	**07**
Q.3	**(a)**	List out the various factors which limit the rate of solid-liquid extraction.	**03**
	(b)	Discuss criteria for Choice of solvent for absorption.	**04**
	(c)	Develop relation between F-type & K-type mass transfer coefficients.	**07**
		OR	
Q.3	**(a)**	On what factors does the mass transfer rate between two fluid phases depend?	**03**
	(b)	What is Extraction? Give the industrial application of Extraction.	**04**
	(c)	Explain molecular diffusion in gases in detail. Also discuss steady state diffusion of A through non diffusing B.	**07**

Q.4	**(a)**	What is meant by constant underflow extraction operation?	**03**
	(b)	For vacuum operation why packed tower are desirable?	**04**
	(c)	Discuss the various factors for choice between internals packing or the plates.	**07**

OR

Q.4	**(a)**	Define Flooding and weeping with respect to tray towers	**03**
	(b)	Write short note on Bollman extractor.	**04**
	(c)	Discuss in detail the Continuous Vacuum Crystallizer.	**07**
Q.5	**(a)**	What is Crystallization?	**03**
	(b)	What are various criteria for selection of solvent for liquid extraction?	**04**
	(c)	A packed tower is to be designed to recover 98% CO_2 from gas mixture containing 10% CO_2 and 90% air using water. A relation y = 14x can be used for equilibrium conditions where y is $\frac{kg\ CO2}{kg\ dry\ air}$ and x is $\frac{kg\ CO2}{kg\ water}$ The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if HTU is 1 meter.	**07**

OR

Q.5	**(a)**	How do you define selectivity?	**03**
	(b)	Give stepwise procedure to determine Minimum Liquid gas ratio for absorbers.	**04**
	(c)	It is required to extract picric acid from a dilute aqueous solution containing 0.1 mole picric acid per liter of solution using benzene as solvent with a recovery of 80% of the picric acid originally present. Determine the quantity of benzene required per liter of aqueous solution by employing (a) single stage extraction and (b) three stage extraction (cross current) using equal amount of fresh solvent in each stage. The equilibrium data for benzene- picric acid-water system at 25 ^{0}C is given by	**07**

$C_B \times 10^2$	0.0932	0.225	1	2	5	10	18
$m=C_B/C_A$	2.23	1.45	1.705	0.505	0.32	0.24	0.187

Where CB and CA are the equilibrium concentration of picric acid in benzene and aqueous phases respectively in mole/liter.

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