Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER– V EXAMINATION – SUMMER 2026

Subject Code:3150501 Date:25-05-2026

Subject Name:Mass Transfer Operations I

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define: Decoction, Absorption factor, Plait point	**03**
	(b)	Explain Fick's law in brief discuss about N and J flux.	**04**
	(c)	Enlist the tower internals for packed and tray tower and explain their roles. Also compare Tray tower with Packed tower.	**07**
Q.2	**(a)**	Classify G-L mass transfer operations and give examples of each operation.	**03**
	(b)	Deduce an equation for molar flux for equimolal counter-current diffusion in case of steady state molecular diffusion for gas phase.	**04**
	(c)	In an oxygen–nitrogen gas mixture at 1 atm. 25°C, the concentrations of oxygen at two planes 0.2 cm apart are 10% and 20% (by volume) respectively. Determine the flux of oxygen when (i) nitrogen is non-diffusing and (ii) there is equimolar counter diffusion. Diffusivity of oxygen in nitrogen is 0.215 cm^2/s.	**07**
		OR	
	(c)	Determine the flux of butanol at 20°C under unidirectional steady state conditions through a 0.1 cm thick film of water when the concentrations of butanol at the opposite sides of the film are, respectively 10% and 4% butanol by weight. The diffusivity of butanol in water solution is 5.9×10^{-6} cm^2/sec. The densities of 10% and 4% butanol solutions at 20°C may be taken as 0.971 and 0.992 g/cc respectively. Also determine the flux if equimolal countercurrent diffusion is taking place.	**07**
Q.3	**(a)**	1000 kg of crushed oil seed (19.5 % oil and 80.5 % meal) is extracted with 1500 kg of pure hexane in a single stage batch extraction vessel. Determine coordinates of point M1 representing mixture of solid- solvent.	**03**
	(b)	At high temperature, two pair partially soluble liquid system behaves like one pair partially soluble liquid system. Agree or not? Support the answer.	**04**
	(c)	A gas containing 4 % cyclohexane and rest inert has to be treated with Non-volatile absorption oil in a packed tower. It is required to remove 98 % of cyclohexane of the gas. The feed solvent is free from cyclohexane. If the feed gas rate is 80 kmol/hour, calculate the minimum solvent rate and actual liquid rate if it is 1.8 times of L_{smin}. Equilibrium relation is given $Y = 0.2X / (1+0.8X)$	**07**
		OR	
Q.3	**(a)**	Discuss various parameters to be considered for selecting solvent for Liquid-Liquid Extraction. For single stage, determine distribution coefficient if feed, pure solvent and extract amounts are 500, 400 and 600 kg respectively. Feed and extract has 45% and 30 % solute respectively.	**03**

(b) Discuss the effect of agitation and temperature on leaching? "High temperature is not always preferable for leaching." Justify the statement. **04**

(c) Pure isopropyl ether of 450 kg/h is being used to extract an aqueous solution of 30 wt % acetic acid by counter-current multistage extraction. Rate of aqueous solution is one third of solvent rate. The exit acid concentration in the aqueous phase is 10 wt %. Calculate the number of stages required. Data on wt % basis is given: **07**

Aqueous phase			Ether phase		
Acetic acid	water	Ether	Acetic acid	water	Ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4
6.42	91.7	1.9	1.93	1	97.1
13.3	84.4	2.3	4.82	1.9	93.3
25.5	71.1	3.4	11.4	3.9	84.7
36.7	58.9	4.4	21.6	6.9	71.5
44.3	45.1	10.6	31.1	10.8	58.1
46.3	37.1	16.5	36.2	15.1	48.7

Q.4 **(a)** Differentiate between physical and chemical adsorption and cite examples of the same. "Absorption is preferable at low T and high P." True or false/? Justify. **03**

(b) Explain Shanks's system with neat sketch. **04**

(c) State various theories of mass transfer co-efficient and discuss film theory at length. Also derive its equation and mention its limitations. **07**

OR

Q.4 **(a)** Define HETP, NTU, Stripping factor **03**

(b) Explain min L/G ratio with neat sketch for gas absorption. "Absorber cannot be operated at min L/G" Justify. **04**

(c) Enlist different industrial liquid extraction equipment and explain any one in detail with neat sketch. **07**

Q.5 **(a)** Define: Weeping, Coning, Dumping **03**

(b) Define super saturation and discuss Mier's theory. **04**

(c) Explain Swenson walker equipment with neat sketch. **07**

OR

Q.5 **(a)** Discuss steps of crystallization. **03**

(b) The solubility of copper sulphate in water at 80 °C is 55 g CuSO4 per 100 g of water and that at 30 °C is 25 g CuSO4 / 100 g water. One ton of saturated solution at 80 °C is slowly cooled down to 30 °C. 5 % water is lost by evaporation. Determine weight of crystals and mother liquor. Hydrated form is represented as $CuSO_4 \cdot 5H_2O$. **04**

(c) Enlist different industrial leaching equipment and explain any one in detail with neat sketch. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3150501 Date:15-05-2025

Subject Name:Mass Transfer Operations I

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q-1	**(a)**	Discuss Fick's law of diffusion.	**03**
	(b)	Differentiate between N flux and J flux.	**04**
	(c)	Derive the equation of N flux for steady state diffusion of A through non-diffusing B for gases.	**07**
Q-2	**(a)**	Define the following terms with respect to packed tower a) Flooding b) loading c) liquid hold up	**03**
	(b)	Discuss Random packing	**04**
	(c)	In an Oxygen-Nitrogen gas mixture at 1 atm, 25 ºC, the concentrations of oxygen at two planes of the film 3mm apart are 10% and 20% by volume. Calculate the Rate of diffusion of oxygen in kmol/ m^2s for the case where there is an equimolar counter diffusion of the two gases. The diffusivity of the system is 0.206 m^2/s.	**07**
		OR	
	(c)	Benzene is stored in a tank of 10.0 m diameter and open at the top. A stagnant air film 10 mm thick is covering the surface of Benzene Beyond which the benzene is not present. Atmospheric temperature is 25 ºC and vapor pressure of Benzene is 150 mm Hg and its molar diffusivity is 0.02 m^2/hr. Calculate the Rate of diffusion in kmol/ m^2hr.	
Q-3	**(a)**	Discuss how solvent solubility affects the extraction process.	**03**
	(b)	Classify gas-liquid mass transfer operations.	**04**
	(c)	A tower packed with 0.5 cm Raschig rings of 12 m height is to be used for absorption of H_2S from natural gas by using mono ethanolamine as a solvent. The operation is counter currently carried out at temperature 30 ºC and pressure 1 atm. The entering gas contains 18% H_2S by volume, 90% of which has to be absorbed. The gas flow rate is 2000 m^3/m^2 hr.The equilibrium data is governed by y= 1.1x. Operating line is straight and parallel to the equilibrium line. Calculate liquid flow rate.	**07**
		OR	
Q-3	**(a)**	Briefly explain diffusivity of liquids.	**03**
	(b)	Discuss the principle of inter phase mass transfer with neat sketch.	**04**

PTO

	(c)	A packed tower is to be designed to absorb sulfur dioxide from air by scrubbing the gas with water. The entry and exit gas concentrations are 20% and 0.5% SO_2 by volume respectively. The entering water is SO_2 free. The actual water flow is twice the minimum. The air flow rate (on SO_2 free basis) is 975 kg/hr m^2.The temperature is 30 ^oC and pressure is 2 atm. The equilibrium data is governed by y = 21.8x. Compute the number of gas transfer units.	**07**
Q-4	**(a)**	Discuss characteristics of a good solvent for extraction process.	**03**
	(b)	Discuss the method to determine minimum gas liquid ratio for absorber with neat sketch	**04**
	(c)	Discuss single stage extraction and develop equations to determine the quantity of extract and raffinate.	**07**
		OR	
Q-4	**(a)**	Explain the function of following: a) Down spout b) Weir c) Entrainment eliminator	**03**
	(b)	Discuss material balance over a counter current absorber.	**04**
	(c)	Discuss working of Agitated vessels for leaching batch process.	**07**
Q.5	**(a)**	Define: a) Absorption factor b) tray efficiency c) selectivity	**03**
	(b)	Explain working of Venturi scrubber.	**04**
	(c)	Explain construction and working of Rotocell with neat sketch.	**07**
		OR	
Q.5	**(a)**	Discuss bubble cap trays briefly.	**03**
	(b)	Describe Swenson-Walker crystallizer.	**04**
	(c)	Explain equilibrium diagrams in leaching operation with neat sketch.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2024

Subject Code: 3150501 Date:18-05-2024

Subject Name: Mass Transfer Operations I

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Explain design principles of mass transfer equipment.	**03**
	(b)	Discuss the effect of temperature and pressure on diffusivity for gases and liquids. For a gaseous system, D_{AB} = 0.202 cm^2/s at 25 °C. Determine diffusivity (m^2/s) of that system at 40 °C if pressure is halved and other parameters remain constant.	**04**
	(c)	Ethanol vapor is diffusing through a layer of water vapor under equimolar counter diffusion at 35 ºC and 1 atm. pressure. The molal concentration of alcohol on the two sides of the gas film (water vapor) 0.3 mm thick are 80% and 10% respectively. Assuming the diffusivity of alcohol–water vapor to be 0.18 cm^2/s, (i) Determine the rate of diffusion of alcohol and water vapor in kg/hr through an area of 100 cm^2 (ii) if the water vapor layer is stagnant, estimate the rate of diffusion of alcohol vapor.	**07**
Q.2	**(a)**	Define: Decoction, Stripping factor, Plait point	**03**
	(b)	Compare and contrast N and J type of flux.	**04**
	(c)	Classify Gas-Liquid equipment in details and compare packed tower with tray tower. Also compare random and regular packings.	**07**
		OR	
	(c)	Deduce an equation for molar flux for diffusion of component A through non-diffusing component B in case of steady state molecular diffusion for liquid phase as well as gaseous phase.	**07**
Q.3	**(a)**	In a wetted wall column, Carbon dioxide is being absorbed from air by water flowing at 2 atm and 25 ºC. The MTC k_y' is to be $6.78*10^{-5}$ $kmol/m^2s$ mole fraction. Determine rate of absorption if partial pressure of carbon dioxide at interface is 0.2 atm and the air is pure. Also determine k_y and k_g.	**03**
	(b)	For a multistage counter-current liquid extraction operation, carry out material balance and explain it.	**04**
	(c)	If 1000 kg/h of a nicotine (C)-water (A) solution containing 1% nicotine is to be counter currently extracted with kerosene at 20°C to reduce the nicotine content to 0.1%, determine (a) the minimum kerosene rate and (b) the number of theoretical stages required if 1150 kg of kerosene is used per hour	**07**

x (kg nicotine/ kg water)	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0204
y* (kg nicotine/ kg water)	0	0.000807	0.001961	0.00456	0.00686	0.00913	0.01870

OR

Q.3	**(a)**	Discuss in detail the pre-treatment as parameter affecting leaching.	**03**
	(b)	Interrelate k_G, k_C, k_y with F type MTC for gaseous phase. Also mention their units.	**04**

(c) Pure isopropyl ether of 450 kg/h is being used to extract an aqueous solution of 30 wt % acetic acid by counter-current multistage extraction. Rate of aqueous solution is one third of solvent rate. The exit acid concentration in the aqueous phase is 10 wt %. Calculate the number of stages required. Data on wt % basis is given: **07**

Aqueous phase			Ether phase		
Acetic acid	water	Ether	Acetic acid	water	Ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4
6.42	91.7	1.9	1.93	1	97.1
13.3	84.4	2.3	4.82	1.9	93.3
25.5	71.1	3.4	11.4	3.9	84.7
36.7	58.9	4.4	21.6	6.9	71.5
44.3	45.1	10.6	31.1	10.8	58.1
46.3	37.1	16.5	36.2	15.1	48.7

Q.4 **(a)** Explain the effect of temperature on the ternary diagram for a system of three liquids with one pair partially soluble **03**

(b) Brief about the Shanks system for leaching. **04**

(c) Ammonia is diffusing through an inert air film 2 mm thick at a temperature of 20 ºC and a pressure of 1 atm. The concentration of ammonia is 10% by volume on one side of the film and zero on the other side. Determine the mass flux. Estimate the effect on the rate of diffusion if the pressure is increased to 10 atm. The diffusivity of NH_3 in air at 20°C and 1 atm. is 0.185 cm^2/s. **07**

OR

Q.4 **(a)** Explain selectivity and distribution coefficient. Explain equilateral triangular co-ordinate and the mixture rule. **03**

(b) Brief about the working of Ballman extractor. **04**

(c) Explain Interphase mass transfer in detail. Also derive expression for overall and local mass transfer coefficient. **07**

Q.5 **(a)** Define: Coning, HETP, Weeping **03**

(b) Define super saturation and discuss Mier's theory in detail. **04**

(c) An air–NH_3 mixture containing 20 mole % of NH_3 is being treated with water in a packed tower to recover NH_3. The inlet gas rate is 700 kg/hm^2. The water used is 1.5 times the minimum and enters the tower with 2% of NH_3. Under these conditions, 90% of NH_3 is absorbed from the feed. Determine Gs, inlet and outlet mole ratio of ammonia in gas stream and liquid stream. **07**

Also mention steps in detail to determine number stages graphically for a counter current absorber.

OR

Q.5 **(a)** Write a brief note on steps of crystallization. **03**

(b) A solution of sodium carbonate available at a temperature of 40°C with a solute content of 30%. Calculate the weight of Na_2CO_3* $10H_2O$ crystal formed if 2000 kg of this solution is cooled to 10°C. Also determine the yield. **04**

Data: Solubility at 10°C = 12.5 gm of Na_2CO_3/100 gm of water

(c) Compare absorption and stripping. For absorption, discuss Minimum L/G. Also mention step to find L_{min}/G using proper diagram. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER- V EXAMINATION-SUMMER 2023

Subject Code: 3150501 Date: 26/06/2023

Subject Name: Mass Transfer Operations I

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define: 1) Mass Transfer 2) Equilibrium 3) Mass transfer Co-efficient	**03**
	(b)	Define molecular diffusion. Derive the equation for steady state diffusion of liquid A through non diffusing liquid B.	**04**
	(c)	Derive the equation which shows relationship between overall mass transfer coefficients (represented by K_y and K_x) and individual mass transfer coefficients (represented by k_y and k_x) with neat digram.	**07**
Q.2	**(a)**	State Fick's law of diffusion and prove that $D_{AB} = D_{BA}$**.**	**03**
	(b)	Explain the concept of penetration theory with neat sketch and suitable assumptions.	**04**
	(c)	Alcohol vapor is being absorbed from a mixture of alcohol vapor and water vapor by means of a nonvolatile solvent in which alcohol is soluble but water is not. The temperature is 97 ^{0}C and the total pressure is 760 mm Hg. The alcohol vapor can be considered to be diffusing through a film of alcohol-water-vapor mixture 0.1 mm thick. The mole % of alcohol in the vapor at the outside of the film is 80%, and that on the inside, next to the solvent is 10%. The diffusivity of alcohol-water-vapor mixture at 25 ^{0}C and 1 atm is 0.15 cm^2/ sec. Calculate the rate of diffusion of alcohol vapor in kg per hour if the area of the film is 10 m^2.Moleculer weight of Alcohol = 46 g/mol	**07**
		OR	
	(c)	At 293 K solubility of ammonia in water is given by Henry's law p=0.3672 C, where p is in atmosphere and C is in kmol/m^2. A mixture of 15 % ammonia and 85 % air by volume at 1 atm is in contact with an aqueous solution containing 0.147 gmol/lit. The air velocity is such that k_G/ k_L=0.9. Find the concentration of ammonia and partial pressure at interface.	**07**
Q.3	**(a)**	Explain the solvent selection criteria for Absorption.	**03**
	(b)	Give stepwise procedure for determining minimum liquid to gas ratio for absorbers.	**04**
	(c)	An air-NH_3 mixture containing 5% NH_3 is being scrubbed with water in a packed tower to recover 95% NH_3. G_1= 3000 kg/h m^2, Ls= 2500 kg/h m^2. Tower is maintained at 25 ^{0}C and 1 atm pressure. Find NTU and height of the tower. The equilibrium relation is given by y*= 0.98x, where x and y are mole fraction units. K_Ga= 65 kmol/h m^3 atm.	**07**
		OR	
Q.3	**(a)**	Define any **THREE**: 1) Tie-line 2) Binodal curve 3) Solutropic solution 4) Plait point	**03**
	(b)	Deduce equation of solvent to feed ratio for single stage liquid-liquid extraction.	**04**

(c) Water- dioxane solution is to be separated by extraction process using benzene as solvent. At 25 ^{0}C the equilibrium distribution of dioxane between water and benzene is as follows: **07**

Wt % of dioxane in water	5.1	18.9	25.2
Wt % of dioxane in benzene	5.2	22.5	32.0

At these concentrations water and benzene are substantially insoluble. 1000 kg of a 25% dioxane water solution is to be extracted to remove 95% of dioxane. The benzene is dioxane free. Calculate minimum solvent required in kg/ hr if the extraction is done in countercurrent fashion. Estimate the number of stages needed if 1.5 times the minimum amount of solvent is used.

Q.4 **(a)** Define: 1) Entrainment 2) Weeping 3) Channeling **03**

(b) With neat sketch discuss Wetted wall column for gas-liquid contact operation. **04**

(c) Calculate the rate of diffusion of acetic acid (A) across a film of non-diffusing water (B) solution 2 mm thick at 17^{0}C, when the concentration on the opposite sides of the film are 9% and 3% acid (by weight). The diffusivity of acetic acid in the solution is $0.95*10^{-9}$ m^2/sec. Density of 9% and 3% by weight acid are 1012 kg/ m^3 and 1003 kg/m^3 respectively. **07**

OR

Q.4 **(a)** Explain the concept of Equilateral –Triangular Coordinates in liquid liquid extraction. **03**

(b) Explain with neat sketch the working mechanism of Ballman Extractor. **04**

(c) Differentiate between tray tower and packed tower. **07**

Q.5 **(a)** Mention different types of packing for gas absorption operation and their selection criterion. **03**

(b) Explain Meir's super saturation theory of crystallization with neat sketch. **04**

(c) Calculate the yield of $MgSO_4*7H_2O$ crystals when 1000 kg saturated solution of $MgSO_4$ at 353 K (80^{0}C) is cooled to 303 K (30^{0}C), assuming 10 % of the water is lost by evaporation during cooling. **07**
Solubility of $MgSO_4$ at 353 K (80^{0}C) = 64.2 kg / 100 kg water
Solubility of $MgSO_4$ at 303 K (30^{0}C) = 40.8 kg / 100 kg water
Atomic weight: Mg=24, S=32, O=16, H=1

OR

Q.5 **(a)** Give unit of Diffusivity. How to predict the diffusivity in gases? **03**

(b) Explain mass, heat and momentum transfer analogies. **04**

(c) What is leaching? What are the industrial applications of leaching? Discuss the different types of equilibrium diagram for leaching **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3150501 Date:04/06/2022

Subject Name:Mass Transfer Operations I

Time:02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	(a)	State and discuss the Fick's law of Diffusion along with the significance of N & J flux.	03
	(b)	Prove that $D_{AB} = D_{BA}$.	04
	(c)	Discuss in brief about choice of separation methods.	07
Q.2	(a)	Derive the relation for steady state diffusion of A through non-diffusing B.	03
	(b)	Ammonia is diffusing through a stagnant gas mixture consisting of 1/3 N_2 and 2/3 H_2 by volume. The total pressure is 206.8 kN/m^2 and temperature 54^0C. Calculate the rate of diffusion of ammonia through a film of gas 0.5 mm thick, when concentration change across the film is 10 % to 5% by volume. The diffusivity of ammonia in gas mixture is 2.45×10^{-5} m^2/s.	04
	(c)	A volatile organic compound C_6H_6 costing Rs. 6/kg is stored in a tank of 10 m. dia. and open at top. A stagnant air film 10 mm thick is covering the surface of the compound beyond which the compound is deficient. If temp. is 25 ^OC and vapor pressure of the compound is 150 mm Hg and diffusivity is 0.02 m^2/hr. calculate the loss in Rs/day.	07
		OR	
	(c)	State the assumptions of film theory and derive the relation for mass transfer coefficient.	07
Q.3	(a)	Derive the relation for two film resistance theory in terms of overall mass transfer coefficient for gas and liquid.	03
	(b)	Write a short note on loading and flooding in packed tower.	04
	(c)	Expound briefly with neat sketch the working of tray tower and the problems associated with its working.	07
		OR	
Q.3	(a)	State the characteristics of ideal solution.	03
	(b)	Discuss the selection criteria for solvent in absorption.	04
	(c)	A coal gas is to be freed of its light oil by scrubbing with wash oil as an absorbent. The circumstances are as follows: Absorber: Gas in 0.250 m^3/s at	07

26°C, Pt = 1.07×10^5 N/m^2, containing 2.0% by volume of light oil vapors. The light oil will be assumed to be entirely benzene, and a 95% removal is required. The wash oil is to enter at 26°C, containing 0.005 mole fraction benzene and has an average molecular weight 260. An oil circulation rate of 1.5 times the minimum is to be used. Wash oil-benzene solutions are ideal. The temperature will be constant at 26°C. At 26°C, the vapor pressure of benzene is 13330 N/m^2. Compute the oil circulation rate.(Solve analytically)

Q.4 **(a)** State the mixture rule **03**

(b) Write a short not on the system of three liquids-one pair partially soluble in extraction. **04**

(c) State the selection criteria for solvent in extraction. **07**

OR

Q.4 **(a)** Write a short note on heap leaching. **03**

(b) Expound briefly the Shanks system. **04**

(c) A solution of nicotine in water containing 1% nicotine is to be extracted with kerosene at 293 k. Water and kerosene are essentially insoluble. The equilibrium relation is **07**

$$y' = 0.9\,x'$$

Determine the % extraction of nicotine if 100 kg of feed solution is extracted with 150 kg solvent.
Repeat for three theoretical stages using 50 kg solvent each.

Q.5 **(a)** Explain equilibrium diagrams in leaching. **03**

(b) Write in short about preparation of solids in leaching. **04**

(c) State the various leaching equipments and explain the working of Bollman extractor. **07**

OR

Q.5 **(a)** Define super saturation and state the techniques to achieve it. **03**

(b) Explain with neat schematic diagram the working of Oslo Krystal evaporative crystallizer. **04**

(c) Calculate the yield of MgSO4.7H2O crystals when 1000 kg saturated solution of MgSO4 at 353 k is cooled to 303 k assuming 10% of the water is lost by evaporation during cooling. **07**

Data Given:
Solubility of MgSO4 at 353 K = 64.2 kg/100 kg of water.
Solubility of MgSO4 at 303 K = 40.8 kg/100 kg water.

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