P P SAVANI UNIVERSITY

Fourth Semester of B. Tech. Examination
December 2022
SECH2080 MASS TRANSFER OPERATION I

05.12.2022, Saturday   Time: 01:00 p.m. To 3:30 p.m.   Maximum Marks: 60

Instructions:
1. The question paper comprises two sections.
2. Section I and II must be attempted in same answer sheet.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculators is allowed.

SECTION – I

			CO	BTL
Q - 1	Answer any five of the Following: (MCQ/Short Question/Fill in the Blanks)	[05]		
(i)	Fick's law is given by the formula		1	1
	a) $N_b = -D_b c \, dC_b/dx$ b) $N_b = -2 D_b c \, dC_b/dx$			
	c) $N_b = -3 D_b c \, dC_b/dx$ d) $N_b = -4 D_b c \, dC_b/dx$			
(ii)	Consider loss of ethanol vapor by diffusion from a half-filled open test tube. At what point in the diffusion path will the contribution of the bulk flow term to the molar flux be maximum?		1	1
	a) At the liquid-gas interface b) In the bulk liquid			
	c) In the bulk gas d) None of the mentioned			
(iii)	Prandtl number is given by		1	1
	a) V/α b) $2 V/\alpha$ c) $3 V/\alpha$ d) $4 V/\alpha$			
(iv)	Sherwood number is given by		1	1
	a) $3/2 \, h_m L/D$ b) $\frac{1}{2} h_m L/D$ c) $3 h_m L/D$ d) $h_m L/D$			
(v)	Sherwood number is a function of		1	1
	a) Lewis number and Reynolds number			
	b) Prandtl number and Lewis number			
	c) Reynolds number and Schmidt number			
	d) Schmidt number and Lewis number			
(vi)	The real driving force of the mass transfer is		1	1
	a) Chemical potential b) Physical potential c) Pressure gradient d) Concentration gradient			
(vii)	In which of the following conditions mass transfer will occur spontaneously? C and z is concentration and distance respectively.		1	1
	a) $dC/dz>0$ b) $dC/dz<0$ c) $dC/dz=0$ d) None of the Mentioned			
Q - 2 (a)	Name methods of conducting mass transfer operations. and Define molecular diffusion	[05]	2	3
Q - 2 (b)	Starting from Fick's first law of diffusion for unidirectional binary gas phase, derive the equation to calculate N_A for steady state molecular diffusion of A through non-diffusing B	[05]	1	3
	OR			
Q - 2 (a)	State the unit of diffusivity and State the unit of diffusivity	[05]	1	3
Q - 2 (b)	State and discuss the types of diffusion with suitable example.	[05]	2	3
Q - 3 (a)	Define J factors for heat and mass transfer. State its applications and limitations	[05]	2	3
Q - 3 (b)	Describe a method to estimate the diffusivity of a volatile solvent into air.	[05]	2	3
	OR			
Q - 3 (a)	The molar composition of a gas mixture at 273 K and $1.5 * 10^5$ Pa is: O 2 7%, CO 10%, CO 2 15%, N 2 68% Determine	[05]	2	4

a) the composition in weight percent

b) average molecular weight of the gas mixture

c) density of gas mixture

d) partial pressure of O_2

Q - 3 (b)	Explain Ficks First law and What is eddy diffusion?	[05]	1	3
Q - 4	Attempt any one/two.	[05]		
(i)	Explain Reynolds Analogy and Chilton – Colburn Analogy		3	4
(ii)	A stream of air at 100 kPa pressure and 300 K is flowing on the top surface of a thinflat sheet of solid naphthalene of length 0.2 m with a velocity of 20 m/sec. The otherdata are: Mass diffusivity of naphthalene vapor in air = 6 * 10^{-6} m^2/sec		3	4

Kinematic viscosity of air = 1.5 * 10^{-5} m^2 .sec

Concentration of naphthalene at the air-solid naphthalene interface = 1 * 10^{-5}kmol/m³Calculate

(a) the overage mass transfer coefficient over the flat plate

(b) the rate of loss of naphthalene from the surface per unit width

Note: For heat transfer over a flat plate, convective heat transfer coefficient forlaminar flow can be calculated by the equation you may use analogy between mass and heat transfer.

SECTION – II

Q - 1	Answer any five of the Following: (MCQ/Short Question/Fill in the Blanks)	[05]		
(i)	Direct dryers are _____		4	1
	a) Batch driers b) Continuous driers c) Semi-batch driers d) None of the mentioned			
(ii)	For a batch drying, the wet surface should be more compare to dry surface.		4	1
	a) True b) False			
(iii)	Humidification is a		4	1
	a) Mass transfer operation b) Heat transfer operation			
	c) Simultaneous heat and mass transfer d) Neither mass and heat transfer operation			
(iv)	By differencing the temperature, heat added or removed is		4	1
	a) Sensible heat b) Latent heat			
	c) Heat of vaporization d) None of the mentioned			
(v)	The humidity is represented in		4	1
	a) Humidity chart b) Psychometric chart			
	c) Psychometric chart or humidity chart d) All of the mentioned			
(vi)	Partial pressure equals vapour pressure if it is_____		4	1
	a) Saturated b) Unsaturated			
	c) Isothermal d) None of the mentioned			
(vii)	The system is unsaturated if partial pressure _____ equilibrium vapour pressure.		4	1
	a) Less than b) Greater than c) Equals to d) All of the mentioned			
Q - 2 (a)	Explain the term Humidification and dehumidification with suitable example	[05]	5	3
Q - 2 (b)	Explain Fluidized bed Dryer in detail with appropriate diagrams	[05]	5	3
	OR			
Q - 2 (a)	Explain Tray Dryer in detail with appropriate diagrams	[05]	6	3
Q - 2 (b)	Explain Cooling Tower, its working principle, construction and operation	[05]	6	3
Q - 3 (a)	Discuss agitated batch crystallizer with neat sketch	[05]	4	3
Q - 3 (b)	Define Magma. And super saturation	[05]	4	3
	OR			
Q - 3 (a)	Discuss the concept with principle of crystallization	[05]	5	3

Q - 3 (b)	Explain construction and working of Swenson-Walker Crystallizer with the help of a neat sketch	[05]	5	3
Q - 4	Attempt any one/two.	[05]		
(i)	Discuss the analogy among Heat, momentum and mass transfer.		6	3
(ii)	Explain Meir's super saturation theory of crystallization with neat sketch		6	3

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CO : Course Outcome Number   BTL : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember		
	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create