Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: CH303

Course Name: MASS TRANSFER OPERATIONS -I

Max. Marks: 100 Duration: 3 Hours

(Use of heat and mass transfer data book to be permitted. Graph sheet may be provided)

PART A

Answer any two full questions, each carries 20 marks. Marks

1 a) Obtain expression for the molar flux due to steady state diffusion of component A through component B which is stagnant. (5)

b) Write down the equations relating the overall resistance to mass transfer based on gas phase and liquid phase to the individual gas and liquid phase resistances to mass transfer. Differentiate between gas phase controlled and liquid phase controlled mass transfer. (5)

c) i. Explain the desirable characteristics of packing materials (4)

ii. Explain the working of a venturi scrubber with a neat diagram. (6)

2 a) i. Differentiate between N type and J type fluxes in mass transfer. (3)

ii. State Fick's law of diffusion and explain the terms involved. (3)

b) Explain Reynold's analogy of heat and mass transfer (4)

c) With the help of a neat diagram, explain the features of a tray column used for gas-liquid contact operations (10)

3 a) Explain any five conditions adversely affecting the stable operation of a tray column (5)

b) Name any five packing materials with a rough sketch. (5)

c) Solute A is to be absorbed from a gas mixture flowing at a velocity 8 m/s on a wet solid surface immersed in the flowing stream. It is difficult to determine the mass transfer coefficient experimentally. However, heat transfer data for the same geometry under similar flow conditions are available. Heat transfer coefficient is obtained as 6.4×10^{-2} kW/m^{2}K. The heat capacity and density of the gas mixture are 1 kJ/kgK and 1.15 kg/m^2. Calculate the value of k_c for the given process. Given Pr = 0.77 and Sc = 0.59 for the gas mixture. (10)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	List the desirable properties of an industrial adsorbent.	(5)
	b)	Define cooling range and approach.	(2)
	c)	Derive Kremser equation. State the assumptions clearly.	(8)
5	a)	Define the terms height of transfer unit and number of transfer units and their expression for absorption in a dilute solution.	(4)
	b)	Obtain the relation between the height of overall gas transfer unit and height of individual transfer units.	(4)
	c)	Explain the working of a natural draft cooling tower. Mark important construction details in a neat diagram.	(7)
6	a)	Derive the equation for Langmuir isotherm.	(4)
	b)	Draw temperature profile at the top and bottom of a counter-current cooling tower.	(4)
	c)	Air containing 18% (mole) acetone is scrubbed in a tray column with pure water to remove 90% of its acetone content. What would be the amount of water (20% excess of minimum) required in kg/h to treat air admitted at a rate of 200 kmol/h? The equilibrium relation of mole fractions may be taken as y = 1.6 x. Also determine the number of theoretical plates required.	(7)

PART C

Answer any two full questions, each carries 15 marks.

7	a)	Define equilibrium moisture, free moisture, bound moisture and unbound moisture.	(4)
	b)	Differentiate between drying and evaporation.	(4)
	c)	With the help of a neat diagram, explain the working of an Oslo evaporative crystalliser.	(7)
8	a)	What are the different methods of achieving supersaturation.	(4)
	b)	State and explain the delta-L law of crystal growth.	(3)
	c)	Describe the construction and working of any two batch dryers	(8)
9	a)	Explain the term Ostwald ripening.	(4)
	b)	Differentiate between primary and secondary nucleation.	(4)

c) It took 3 hrs to dry a wet solid from an initial moisture content of 0.21 kg water/kg dry solids to a final moisture content of 0.12 kg moisture/kg dry solids. The critical moisture content and equilibrium moisture content for the given conditions may be taken as 0.15 and 0.05 kg moisture/kg dry solids respectively. How long will it take to dry the solid under the same conditions with an initial moisture content of 0.3 kg moisture/kg dry solid. State the assumptions made, if any. (7)

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