

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2020

Course Code: CH303**Course Name: MASS TRANSFER OPERATIONS -I**

Max. Marks: 100

Duration: 3 Hours

*Psychrometric chart and steam table are allowed
Graph sheets to be provided*

PART A*Answer any two full questions, each carries 20 marks.*

Marks

- 1 a) Derive the equation for steady state diffusion in multi component mixtures. (10)
- c) Benzene is stored in a tank of diameter 10 m and open at the top. A stagnant air film 10 mm thick is covering the surface liquid beyond which benzene is absent. If the atmospheric temperature is 25°C and the corresponding vapour pressure is 150 mm Hg, Diffusivity of benzene is 0.02 m²/hr and total pressure is 1 atm. Estimate the rate of loss of benzene. (10)
- 2 a) Starting from fundamentals, derive an expression for the diffusion of A and B under equimolar counter diffusion conditions. (5)
- b) Explain the method to find the number of stages in counter current cascade by graphical method. (7)
- c) Explain with neat sketch principle and working of venturi scrubber and mention its industrial applications. (8)
- 3 a) Diffusivity of toluene is measured by Stefan's method. A vertical glass tube of 3 mm diameter is filled with toluene to a depth of 19 mm from top open end. After 275 hours at 37 °C and 1 atm. total pressure the level has fallen to 79 mm. from top. Density of toluene is 850 kg/m³ and Vapour Pressure 37 °C is 57.3 mm Hg. Calculate the diffusivity of Toluene in air. (7)
- b) Explain flooding in packed bed absorption column. (5)
- c) With neat sketch, describe the constructional features and design constraints of a packed tower. (8)

PART B*Answer any two full questions, each carries 15 marks.*

- 4 a) Write a note on operating lines with graphs and indicates their positions for absorption and stripping operations. (5)

- b) For dilute mixtures, show that the number of transfer units based the gas phase (10)
for a counter current gas absorption in a packed tower is given by $N_{toG} = \frac{y_1 - y_2}{(\Delta y)_{LM}}$
- 5 a) Acetone-Air mixture containing 5 % (mole) acetone is scrubbed with pure water (7)
in a counter current packed column of diameter 1.5 m in order to remove 95 % of
acetone. The gas mixture enters at a rate 3000 kg/h and the liquid rate is 50 % in
excess of the minimum. Equilibrium data at the operating conditions are (are
mole fractions of acetone).

x	0.01	0.02	0.03	0.04
y	0.02	0.0382	0.0552	0.0697

Determine:

- (a) The liquid rate in kg/h
- (b) The mole percentage of acetone in the exit liquid
- b) Explain adsorption wave and break through curve. (5)
- c) Discuss the nature of adsorbents and applications. (3)
- 6 a) An air–water vapour mixture is available at a DBT 35 °C and a WBT 30 °C. (5)
Estimate its % humidity, dew point, humid heat, absolute humidity and enthalpy.
- b) Explain the principle of wet bulb thermometry and obtain an expression for wet (7)
bulb depression.
- c) Write short note on different type of cooling towers. (3)

PART C

Answer any two full questions, each carries 15 marks.

- 7 a) Explain the classification of dryers giving examples and indicating their field of (5)
application.
- b) With a neat rate curve explain the various regimes of drying. (5)
- c) Obtain an expression to determine the drying time needed to dry a substance (5)
possessing both constant and falling rate drying characteristics.
- 8 a) A crystallizer is charged with 7500 kg of aqueous solution at 104 °C containing (10)
30 % by weight of Na₂SO₄. The solution is then cooled to 20 °C. During this
operation 5 % of the original water is lost by evaporation. Glauber salt
crystallizes and the solubility at 20 °C is 19.4 gm of Na₂SO₄ /100gm of water.
Find the weight of i) Water lost by evaporation ii) Crystals formed iii) Mother
liquor leaving.
- b) Explain different methods of achieving super saturation. (5)

- 9 a) With a neat sketch explain the construction and working of any one type of crystallizer used in industry. (5)
- b) Describe the mechanism of different moisture movements in drying operation. (5)
- c) A wet solid is dried from 40 % moisture to 8% moisture in 4 hrs. How long will it take to dry the material to 5 % moisture under the same drying conditions. Equilibrium moisture content is 4 % and critical moisture content of the material was 15 % (moisture content in wet basis). (5)
