Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PCE3I104

3rd Semester Back Examination 2019-20
MASS TRANSFER - I
BRANCH : CHEM, PT
Max Marks : 100
Time : 3 Hours
Q.CODE : HB887

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) State Fick's Law of Diffusion.
b) Differentiate between absorption and desorption.
c) List the equipments used in absorption.
d) Define dew point and wet bulb temperature.
e) What is —Distribution Coefficient?
f) Define HTU, NTU and give its significance
g) Write the limitations of McCabe Thiele method.
h) Define HETP and give its significance
i) Write the significance of relative volatility in distillation.
j) Define Tray efficiency.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Ammonia gas (A) diffuses through nitrogen gas (B) under steady state conditions with nitrogen non-diffusing. The partial pressure of A at location is 1.5 x 104 Pa and that at location 2 is 5 x 103 Pa. the location 1 and 2 are 15 cm apart. The total pressure is 1.103 x 105 Pa and temperature is 298 K. calculate the flux of diffusion of ammonia. Also calculate flux of diffusion for equimolar counter diffusion assuming that nitrogen is also diffusing. Take diffusivity at prevailing conditions are 2.30 x 10-5 m2 /s.
b) Explain molecular diffusion in gases in detail. Also discuss steady state diffusion of A through non diffusing B.
c) State selection criteria for solvent in extraction.
d) Compare tray tower and packed tower in terms of its advantages and disadvantages.
e) A packed tower is to be designed to recover 98% CO2 from gas mixture containing 10% CO2 and 90% air using water. A relation y = 14x can be used for equilibrium conditions where y is $kg\ CO2/\ kg\ dry\ air$ and x is $kg\ CO2\ kg\ water$ The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if HTU is 1 meter.
f) State different theories of mass transfer co-efficient and explain any one in detail.
g) Explain the procedure to determine the minimum number of theoretical plates by Ponchon Savarit method.
h) 1000 m3 /h of a gas mixture containing 10 mole% solute and rest inert enters the absorber at 300 k temperature and 106.658 kPa pressure. 90% of the original solute is removed. Solute free water used for absorption contains 5 mole% solute when it leaves the tower at the bottom. Calculate the solvent molar flow rate to tower.
i) Explain the process of Azeotropic distillation.
j) Write a short note on dew point method.

k) Air (dry bulb temp. = 34°C; wet bulb temp. = 23°C) is contacted with a sufficient quantity of water at 23 °C in a spray chamber. The water is recycled. Air leaves the chamber 95% saturated. Determine the temperature, the relative humidity and the wet bulb temperature and enthalpy of the exit air.

l) Briefly describe the working principle natural circulated equipments.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 State Fick's first law and compare : (i) Molecular diffusion and Eddy diffusion (ii) N-type flux and J-type flux. **(16)**

Q4 A counter current plate absorber is to be installed for scrubbing of an air mixture containing 5% ammonia by volume. The scrubber is fed with water containing 0.002 mole NH3/mole of water. The scrubber water flows at a rate of 1 mole water/mole of air. It is necessary to absorb 85% of the ammonia present in the gas by operating the absorber at 20 0C. Assume dilute solution, take Henry's law constant = 0.8 mole NH3 / (mole NH3/mole H2O). Calculate number of stages necessary for this operation. **(16)**

Q5 A continuous distillation column is to be designed 7000kg/hr of liquid mixture with 60% methanol and 40 mole% water into an overhead product containing 90 mole% methanol and water product 95 mole% water. Reflux ratio of 2 times the minimum value is used. Assume relative volatility of methanol and water is 3. Calculate (i) the moles of overhead of water product. (ii) Number of ideal trays and feed tray if the feed is at boiling point. **(16)**

Q6 Two air streams are mixed before feeding to a dryer in order to have proper humidity control. Stream 1: flow rate = 2kg/s, temperature = 50 °C, relative humidity = 30%; stream 2: flow rate = 3kg/s, temperature = 25 °C, relative humidity = 50%. Calculate the enthalpy, humidity and temperature of the mixed air stream. The total pressure is 1 atm. **(16)**