Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Programme: B.Tech CE+RP **Semester: V**
Course: Mass Transfer-I **Time: 03 hrs.**
Course Code: CHEG 214 **Max. Marks: 100**
Instructions: In case of data missing make necessary assumptions

SECTION A (5X12=60)

S. No.	**Attempt all questions**	**Marks**	**CO**
Q 1	Define the following: i) stage efficiency ii) molar average velocity iii) weeping iv) entrainment v) chemical equilibrium	**12**	**CO1 & CO5**
Q2	Oxygen is diffusing through a stagnant gas mixture containing 50% methane, 30% hydrogen and 20% carbon dioxide by volume. The total pressure is $1x10^5$ N/m^2 and the temperature is 20 ^oC. The partial pressure of oxygen at two planes 5 mm apart are $13x10^3$ and $6.5x10^3$ N/m^2 respectively. Estimate the rate of diffusion of oxygen. At 0 ^oc and at 1 atm, the diffusivities of oxygen with respect to methane, hydrogen and carbon dioxide are: D_{O2-CH4}=0.184 cm^2/s,D_{O2-H2}=0.690 cm^2/s, and D_{O2-CO2}= 0.139 cm^2/s	**12**	**CO1**
Q 3	Explain the procedure for determination of number of ideal stages for steady state cross current contact.	**12**	**CO3**
Q 4	Discuss differential distillation in detail. Also, derive Raleigh's equation for binary mixture.	**12**	**CO4**
Q 5	Differentiate between tray towers and packed towers.	**12**	**CO5**

SECTION B (2X20=40)

	Attempt any two of the following		
Q 6	A stream of aqueous methanol having 45 mol% CH_3OH is to be separated into a top product having 96 mole% methanol and a bottom liquid with 4% methanol. The feed is at its bubble point and the operating pressure is 101.3 kPa. A reflux ratio of 1.5 is suggested. (a) Determine the number of ideal trays (b) Find the number of real trays if the overall tray efficiency is 40%. On which real tray should the feed be introduced? The equilibrium and bubble point data for the methanol-water system at 101.3 kPa are given below:	**20**	**CO4**

x	0	0.02	0.04	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95	1.0
y	0	0.134	0.23	0.418	0.58	0.665	0.73	0.78	0.825	0.87	0.915	0.958	0.979	1.0
T	100	96.4	93.5	87.7	84.4	78.0	75.3	73.1	71.2	69.3	67.6	66	65	64.5

Q 7	Test tubes of tapered shape are sometimes used in the laboratories. Consider 15 cm tall tapered test tube, open at the top. Half of the tube (to a depth of 7.5 cm) is full of ethyl acetate (A) at 25^{o}C. The diameter of the tube at the top is 18 mm and that at the bottom is 10 mm. Calculate the rate of evaporation loss of the ester at the beginning. And also calculate the time of fall of the level by 2 cm. The ambient temperature is 25 ^{o}C and the pressure is 1.013 bar. The data of the ester are given as follows: molecular weight 88; and density 900 kg/m^3; vapor pressure at 25 ^{o}C is 0.1264 bar; diffusivity in air is 8.66x10^{-6} m^2/s.	**20**	**CO2**
Q 8	Derive the relation between overall and individual mass transfer coefficient for both liquid film and gas film controlling.	**20**	**CO3**