Name: Enrolment No:	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2019

Course: Mass Transfer Equipment Design and Separation Processes **Semester: II**
Program: M.Tech. Chem Engg (with spl in PDE) **Time: 03 hrs**
Course Code: CHPD 7010 **Max. Marks: 100**
No of pages: 02
Instructions: Assume suitable data, if necessary.

SECTION A

S. No.	Answer any 5 questions. Each carries 12 marks. [12X5=60 Marks]	Marks	CO
Q 1	Describe with flow diagram, Atmospheric Distillation Unit (ADU) of the refinery.	12	CO1
Q.2	Elaborate on 'Equilibrium Solubility of Gases in Liquids'.	12	CO2
Q.3	Discuss 'Choice of Solvent for Liquid-Liquid Extraction.	12	CO3
Q.4	Explain the types of adsorption in detail.	12	CO4
Q.5	Describe with neat sketch, simulation of moving beds for adsorption.	12	CO4
Q.6	Define and explain osmosis and reverse osmosis. Enlist the applications of reverse osmosis along with advantages.	12	CO5

SECTION B

S. No.	Answer both the questions. [35+5 = 40 Marks]		
Q.7	100 kg of a solution of acetic acid(C) and water (A) containing 30 wt% acid is to be extracted with fresh isopropyl ether (B) at 20^0C, in a three stage cross-current liquid extraction. The quantity of solvent to be used in each stage is same i.e. 40 kg. Determine the quantities and compositions of the various streams. How much solvent would be required, in order to achieve same final raffinate concentration, in a single stage cross-current liquid extraction? The equilibrium tie line data at 20^0C are as follows:	**35**	**CO3**
Q.8	An aqueous solution is colored by small amounts of an impurity. It is desired to reduce the color by adsorption. Initial concentration of color is 9.6 units of color / kg solution. It is desired to reduce the color by 90% of its original value. Determine the quantity of fresh carbon required per thousand kg of solution for a single stage operation. Assume equilibrium condition. Equilibrium data at constant temperature:	**05**	**CO4**

Water layer			Isopropyl ether layer		
Wt % acetic acid, $100x$	Water	Isopropyl ether	Acetic acid, $100y^*$	Water	Isopropyl ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4
6.42	91.7	1.9	1.93	1.0	97.1
13.30	84.4	2.3	4.82	1.9	93.3
25.50	71.1	3.4	11.40	3.9	84.7
36.70	58.9	4.4	21.60	6.9	71.5
44.30	45.1	10.6	31.10	10.8	58.1
46.40	37.1	16.5	36.20	15.1	48.7

kg carbon/kg soln	0	0.001	0.004	0.008	0.02	0.04
Equilibrium color units of color/kg solution	9.6	8.6	6.3	4.3	1.7	0.7