Name:

Enrolment No:

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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Semester Examination, June 2021

Course: Mass Transfer Equipment Design and Separation Processes — **Semester: II**
Program: M.Tech. Chem. Engg. with spl in PDE — **Time: 3 hrs**
Course Code: CHPD7010 — **Max. Marks: 100**
Assume suitable data, if necessary.

SECTION A (Type the answer type)

Q. No.	Short answer type questions. Each carries 5 marks. 5X6 = 30 marks	Marks	CO
Q 1	Distinguish between tray towers and packed towers.	5	CO1
Q.2	Describe the choice of solvent for gas absorption w.r.t. gas solubility and volatility.	5	CO2
Q.3	Explain the properties of supercritical fluid solvents.	5	CO3
Q.4	Define the term 'Adsorption' and compare Physical adsorption with Chemical one.	5	CO4
Q.5	Differentiate between Osmosis and Reverse Osmosis.	5	CO5
Q.6	Explain the construction and working of a hollow fiber membrane module. Diagram is not required.	5	CO5

SECTION B (Scan and upload type)

Q. No.	Medium answer type questions. Each carries 10 marks. 10X5 = 50 marks	Marks	CO
Q.1	A distillation column produces a distillate containing 61.54 mol% n-propane (C3), 38.1 mol% n-butane (C4) and 0.38 mol% n-pentane (C5). The bubble point of distillate is 60 ^{o}C. Estimate column top and bottom pressure. Assume pressure drop across the column to be ** kPa. Take 1500 kPa as a first trial value for calculation of column top pressure. Only two trials are expected. **<u>Data for Equilibrium Constant K</u>** **Temp, ^{o}C** | **Pressure, kPa** | **K_{C3}** | **K_{C4}** | **K_{C5}** 60 | 1500 | 1.4 | 0.52 | 0.21 60 | 1600 | 1.35 | 0.5 | 0.20 ** indicates last two digits (in the same order) of respective student's SAP ID.	10	CO1

<table>
<tr><td>Q.2</td><td>In a chemical industry, a gas containing 4 mol% ammonia and 96 mol% air is to be treated with fresh water in a packed tower. The tower operates counter currently, with gas entering at the bottom while liquid entering at the top. It is desired to remove 98% of the ammonia of the feed gas. Estimate the solvent rate and concentration of ammonia in the exit liquid, if the feed rate is 80 kmol/h. Take the slope of operating line to be 0.19</td><td>10</td><td>CO2</td></tr>
<tr><td>Q.3</td><td>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 two stage cross-current liquid extraction. The quantity of solvent to be used in each stage is same i.e. 40 kg. Determine the mass of extract and raffinate streams leaving each stage. The equilibrium concentrations of extract and raffinate streams leaving respective stage is given below.

<table><tr><th>Stage</th><th>1</th><th>2</th></tr><tr><td>x</td><td>0.258</td><td>0.227</td></tr><tr><td>y</td><td>0.117</td><td>0.095</td></tr></table>
Where x = weight fraction of solute in raffinate
y = weight fraction of solute in extract</td><td>10</td><td>CO3</td></tr>
<tr><td>Q.4</td><td>***kg of a waste oil having an initial color concentration of 50 units per kg oil has to be treated in a batch process to reduce the concentration to 1 color unit per kg oil. Calculate the minimum quantity of adsorbent (clay) required. The equilibrium relation is given below.

$X^* = 2381\ Y$

Where X^* = Number of color units per kg clay in equilibrium

Y = Number of color units per kg oil

***indicates a number formed by 5^{th}, 6^{th} & 7^{th}digit (from left) of respective student’s SAP ID keeping the same order.

What will be the color concentration in clay if 1.2 times minimum adsorbent is used and operation is stopped as soon as final concentration (1 color unit per kg oil) is reached? Rest is unchanged.</td><td>10</td><td>CO4</td></tr>
<tr><td>Q.5</td><td>Describe with diagram, an electrodialysis process.</td><td>10</td><td>CO5</td></tr>
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SECTION-C (Scan and upload type)			
Q. No.	**Long answer type question. It carries 20 marks. 1X20 = 20 marks**	**Marks**	**CO**
Q.1	Describe with flow diagram, 'Batch Supercritical Fluid Extraction Plant'. Also, give the advantages of supercritical fluid solvents over liquid solvents. **OR** Elaborate on 'Choice of Solvent for Liquid-Liquid Extraction'.	**20**	**CO3**