Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, February 2021

Programme Name: B. Tech. (APE-Gas) **Semester : III**
Course Name : Material & Energy Balance Computations **Time : 3 hrs**
Course Code : CHCE 2013 **Max. Marks: 100**
Nos. of page(s) : 03
Instructions : Assume any missing data. Draw the diagrams, wherever necessary.

SECTION A
(6X5=30 marks)

1	Define Limiting & excess reactants	**5**	**CO2**
2	Define Raoult's Law. What are the characteristics of ideal solutions?	**5**	**CO3**
3	Define Adiabatic saturation temperature & Wet bulb temperature	**5**	**CO4**
4	Differentiate between Distillation & evaporation	**5**	**CO5**
5	Explain the difference between purge & Bypass operations	**5**	**CO5**
6	Define standard heats of formation & Kopp's rule	**5**	**CO6**

SECTION B
(5X10=50 marks)

S. No.		**Marks**	**CO**
1	A liquefied mixture of methane, butane and propane has the compositions of 30, 30 and 40 percent respectively by volume. Find mol%, weight %, and average molecular weight of the mixture.	**10**	**CO1**
2	Alumina (Al) reacts with chlorine gas to form aluminum chloride via the following reaction: $2Al + 3Cl_2 \rightarrow 2AlCl_3$ How many grams of aluminum chloride could be produced from 34 g of aluminum and 39 g of chlorine gas? Find limiting reactant, Excess reactant, percent excess reactant, yield of aluminum chloride with respect to the pure alumina. Atomic mass of Al and Cl are 27 and 35.5 a.m.u.	**10**	**CO2**
3	A 10.20 g sample of a gas has a volume of 5.25 L at 23 °C and 751 mmHg. If 2.30 g of the same gas is added to this constant 5.25 L volume and the temperature raised to 67 °C, what is the new gas pressure?	**10**	**CO3**

<table>
<tr><td>4</td><td>Carbon monoxide combines with chlorine in the presence of suitable catalyst to form phosgene according to the following reaction
$CO(g) + Cl_2(g) \dashrightarrow COCl_2(g)$
After the reaction, the gas contains 12 moles of phosgene, 3 moles of chlorine and 8 moles of carbon monoxide. Assuming that the original reactant mixture is free of phosgene, calculate 1) the percent excess reactant 2) the percent conversion of the limiting reactant 3) moles of total product per mole of reactant fed to reactor</td><td>10</td><td>CO4</td></tr>
<tr><td>5</td><td>1000 kg /h of thermic fluid to be used as a heat transfer medium is being heated using a heater from 380 to 550 K. Calculate the heat load on the heater in KW. The heat capacity of the fluid is given by the equation $Cp=1.436+2.18x10^{-3}T$ where T in K and Cp in kJ/kg K.</td><td>10</td><td>CO6</td></tr>
<tr><td colspan="4">SECTION C
(1 X 20=20 marks)</td></tr>
<tr><td>1</td><td>A tank holds 10000 kg of saturated solution of $NaHCO_3$ at 60 ^oC. You want to crystallize 400 kg of $NaHCO_3$. To what temperature the solution must be cooled. The solubility data for $NaHCO_3$ as a function of temperature is given in the following table:
<table>
<tr><td>Temperature, ^0C</td><td>60</td><td>50</td><td>40</td><td>30</td><td>20</td><td>10</td></tr>
<tr><td>$\frac{g\ of\ NaHCO_3}{100\ g\ of\ water}$</td><td>16.4</td><td>14.5</td><td>12.7</td><td>11.1</td><td>9.6</td><td>8.15</td></tr>
</table>
</td><td>20</td><td>CO5</td></tr>
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