GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2021

Subject Code:2130504   **Date:11/09/2021**

Subject Name:Process Calculation

Time:10:30 AM TO 01:30 PM   **Total Marks:70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	1) Define relative humidity 2) 1 atm = _____ bar. 3) What is molality?	**03**
	(b)	1)) In double effect evaporator plant the second effect is maintain under vacuum of 475torr (mmHg).find the absolute pressure in kpa 2) Converted a Pressure of 2 atm to mm Hg.	**04**
	(c)	Define: (1) limiting reactant (2) selectivity (3) excess reactant (4) law of conservation of energy (5) yield (6) latent heat of vaporization (7) calorific value of fuel	**07**
Q.2	**(a)**	Discuss the methods for solving problems of material balance without chemical reactions	**03**
	(b)	The conductance of a fluid flow system is defined as the volumetric flow rate, Referred to a pressure of one torr (133.233 Pa). For an orifice, the conductance C can be computed from $C= 89.2\ A\ (T/M)^{1/2}$ ft^3/ s where, A = area of opening, ft^2 , T = temperature, ^{0}R, M = Molar mass Convert the empirical equation in SI units.	**04**
	(c)	A solution of caustic soda in water contains 20% NaOH (by weight) at 333 K. The density of the solution is 1.196kg/l. Find the molarity, normality and molality of the solution.	**07**
		OR	
	(c)	20 g of caustic soda are dissolved in water to Prepare 500 ml of solution. Find the normality and molality of the solution.	**07**
Q.3	**(a)**	Define the following terms: (1) excess reactant (2) percentage conversion (3) yield.	**03**
	(b)	Discuss about recycling operations	**04**
	(c)	It is required to make 1000 kg mixed acid containing 60% H_2SO_4, 32% HNO_3 and 8% water by blending (i) the spent acid containing 11.3 % HNO_3, 44.4% H_2SO_4 and 44.3 % H_2O. (ii) Aqueous 90% HNO_3 and (iii) aqueous 98 % H_2SO_4. All percentages are by mass. Calculate the quantities of each of the three acids required for blending	**07**
		OR	

Q.3 **(a)** Discuss about By Pass operations   **03**

(b) Write a short Note on Material Balance and Energy Balance   **04**

(c) Soybean seeds are extracted with hexane in batch extractors. The flaked seeds   **07**
contains 18.6 % oil, 69.0 % solids & 12.4 % moisture cake. At the end of the
extraction process the cake is separated from the hexane oil mixture. The cake
analysis yields, 0.8 % oil, 87.8% solids and 11.5 % moisture. Find the%
recovery of oil .All percentage is on weight basis.

Q.4 **(a)** Define and explain the following terms: **03**
(1) Heat of formation
(2) Heat of combustion
(3) Heat of reaction

(b) Define Raoult's law. What are the applications and limitations of Raoult's law?   **04**

(c) Temperature of pure Oxygen is raised from 350 to 1500 K. calculate the amount of   **07**
heat to be supplied for raising the temperature of 1 kmol oxygen using the following
Cp^o data
$Cp^o = a + bT + cT^2 + dT^3$ KJ/ (Kmol. K)

Gas	a	b x 10^3	c x 10^6	d x 10^9
O_2	26.0257	11.7551	-2.3426	-0.5623

OR

Q.4 **(a)** Discuss methods of solving material balance problems without chemical   **03**
reaction

(b) Describe Pressure-Enthalpy chart for any pure component. What is the value   **04**
of latent heat of vaporization at critical point? Why?

(c) 2000 kg of wet solids containing 70 % solids by weight are fed to a tray dryer   **07**
where it is dried by hot air. The product finally obtained is found to contain
1% moisture by weight, calculate:
 (1). The kg of water removed from wet solids,
 (2). The kg of product obtained

Q.5 **(a)** Discuss methods of solving material balance problems with chemical reaction   **03**

(b) Discuss about proximate analysis of fuel.   **04**

(c) Pure methane gas is heated from 303K to 523K at atmospheric pressure.   **07**
Calculate the heat added per kmole methane using Cp^0 data given below
$Cp^o = a + bT + cT^2 + dT^3$ KJ/ (Kmol. K)

Gas	a	b x 10^3	c x 10^6	d x 10^9
CO_2	19.2494	52.1135	11.973	-11.3173

OR

Q.5 **(a)** Define: **03**
(i) Dry blub temperature
(ii) wet bulb temperature
(iii) Dew point.

(b) Explain: (i) Watson equation   **04**
 (ii) Riedel Equation

(c) 10,000 kg/h of solution containing 20 % methanol is continuously fed to a   **07**
distillation column. Distillate (Product) is found to contain 98% methanol and
waste solution from the column carries 1% methanol. All percentages are by
weight. Calculate
(1) The mass flow rate of distillation and bottom product.
(2) The percentage loss by methyl alcohol.

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