Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2140406 **Date:01/06/2016**

Subject Name:Stoichiometry

Time:10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Mol. Wt:** Na = 23, K=39, O= 16, H=1, N=14, C=12, Mg=24, Ca=40, S=32, Cl=35.5

Q.1		**Short Questions**	**14**
	1	Define Percentage Conversion	**01**
	2	Explain the terms Limiting component and Excess component.	**01**
	3	Give value of universal gas constant in atm.lit/mol.K and $kPa.m^3/kmol.K$	**01**
	4	Define: Standard Heat of reaction	**01**
	5	Differentiate between: Sensible heat and latent heat	**01**
	6	Define: Yield	**01**
	7	Define : Dry-bulb temperature	**01**
	8	Define :Absolute humidity	**01**
	9	How many grams of NH_4Cl are there in 5 moles?	**01**
	10	Define: Selectivity	**01**
	11	Define :Relative humidity	**01**
	12	What is Avogadro's number?	**01**
	13	Define: Fundamental and derived units	**01**
	14	Define :Dew point	**01**
Q.2	**(a)**	Iron metal weighs 200 lb & occupies a volume of 117 L. Find the density in kg/m^3.	**03**
	(b)	A solution of sodium chloride in water contains 20% NaCl (by mass) at 333 K. The density of the solution is 1.127 kg/L. Find the molarity, normality and molality of the solution.	**04**
	(c)	A solution of ethyl alcohol containing 8.6% alcohol is fed at the rate of 1000 kg/h to a continuous distillation column. The product (distillate) is a solution containing 95.5% alcohol. The waste solution from the column carries 0.1% of alcohol. All percentages are by mass. Calculate (a) the mass flow rates of top and bottom products in kg/h and (b) the percentage loss of alcohol.	**07**
		OR	
	(c)	A spent lye sample contains 96% glycerol and 10.3% NaCl salt It is concentrated at the rate of 5000 kg/h in a double effect evaporator until the final solution contains 80% glycerol and 6% salt 45% glycerol is lost by entrainment All the percentage are by mass Determine: (i) the evaporation taken place in the system (ii) the amount of salt crystallized out from the evaporator.	**07**
Q.3	**(a)**	Write short note on recycling operation.	**03**

	(b)	A gas mixture has the following composition by volume: Ethylene: 31%, Benzene: 24%, Oxygen: 1%, Methane: 15%, Ethane: 25%, Nitrogen: Find the average molecular mass of the gas mixture.	**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) spent acid containing 11.3% HNO_3, 44.4% H_2SO_2 and 44.3% H_2O, (ii) aqueous 90% HNO_3 and (iii) aqueous 98% H_2SO_4. All percentage are by weight. Calculate the quantities of each of the three acids required for blending.	**07**

OR

Q.3	**(a)**	The available nitrogen in a urea sample is found to be 45%. Find the actual urea (NH_2-CO-NH_2) content in the sample.	**03**
	(b)	Single effect evaporator concentrating weak liquor containing 4% solids to 55% solids (by weight) is fed with 5000 kg/h of weak liquor. Calculate: a) water evaporated per hour, and b) flow rate of thick liquor.	**04**
	(c)	Pure methane is heated from 303K to 523K at atmospheric pressure. Calculate the heat added per kmole methane using Cp data: $Cp = a + bT + cT^2 + dT^3$. Data for methane: $a = 19.2494$, $b = 52.1135\times 10^{-3}$, $c = 11.973\times 10^{-6}$, $d = -11.3173\times 10^{-9}$.	**07**
Q.4	**(a)**	Write short note on bypass operation	**03**
	(b)	Sodium chloride weighing 600 kg is mixed with 200 kg of Potassium chloride. Find the composition of mixture in mass percentage.	**04**
	(c)	The conductance of a fluid-flow system is defined as the volumetric flow rate, referred to a pressure of one torr (133.322 Pa). For an orifice, the conductance C can be computed from $$C = 89.2A\sqrt{\frac{T}{M}}\, ft^3/s$$ Where A = area of opening.ft^2 T = Temperature, ^{0}R M = Molecular Weight Convert the empirical equation into SI units.	**07**

OR

Q.4	**(a)**	Define: Distillation, Evaporation and crystallization.	**03**
	(b)	In the Deacon process for manufacture of Chlorine, hydrochloric gas is oxidized with air. The reaction taking place is: $4\ HCl + O_2 \rightarrow 2\ Cl_2 + 2\ H_2O$. The air used is in excess of 30% of that theoretically required and the oxidation is 80% complete. Calculate the composition by volume of dry gases leaving the reaction chamber.	**04**
	(c)	The gaseous reaction $A \rightarrow 2B + C$ takes place isothermally in a constant pressure reactor. Starting with a mixture of 75% A and 25% inert (by volume), in a specified time the volume doubles. Calculate the conversion achieved.	**07**
Q.5	**(a)**	Using Antoine equation calculate the vapour pressure of acetic acid at316 K. Data: A=6.5127 B= 1533.30 C= -50.8500	**03**
	(b)	The diameter and height of a vertical cylindrical tank are 5 ft and 6 ft 6 in respectively. It is full up to 75% height with carbon tetrachloride, the density of which is 1.6 kg/L. Find the mass in kilograms and pounds	**04**
	(c)	Formaldehyde is produced from methanol catalytic reactor. The production rate of formaldehyde is 1000 kg/h. If conversion of methanol is 65%, calculate the required feed rate of methanol.	**07**

OR

Q.5	**(a)**	A sample of aqueous triethanolamine (TEA) solution contains 47% TEA	**03**

(on volume basis). If density of pure TEA is 1125 kg/m^3, find the weight % of TEA in the solution.

(b) Discuss methods of solving material balance problems without chemical reaction. **04**

(c) A heat exchanger for cooling a hot hydrocarbon liquid uses 10000 kg/hr of cooling water, which enters the exchanger at 294 K. The hot oil at the rate of 5000 kg/hr enters at 423 K and leaves at 338 K and has an average heat capacity of 2.51 KJ/(kg.K). Calculate the outlet temperature of water. **07**

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