	Seat N	No.: Enrolment No	
		GUJARAT TECHNOLOGICAL UNIVERSITY	
		BE - SEMESTER-IV • EXAMINATION - WINTER • 2014	
	Subi	ect Code: 140504 Data 14 Entrin (11101) (111121) 2011	
	Subj	act Names Fundamental of Chemical Engineering Calculations	
	Subj	And Statistic states	
	-	And Stoicniometry	
	Time	: 02:30 pm - 05:00 pm Total Marks: 70	
	Instru	ctions:	
		1. Attempt all questions.	
		2. Make suitable assumptions wherever necessary.	
		3. Figures to the right indicate full marks.	
0.1	(a)	Define the following terms	07
Q.1	(a)	(1) Viold (2) Down point (2) Latont heat (4) Dry hulh temperature	07
		(1) There (2) Dew point (3) Latent near (4) Dry-build temperature (5) Absolute humidity (6) Wet hulb temperature (7) Limiting component	
	(b)	(5) Absolute humany (6) wet build temperature (7) Emitting component (1) Convert the heat transfer coefficient of value 100 Btu/br ft ² ⁰ E into	04
	(0)	$W/m^2 \ ^0C$	04
		(2) Iron metal weighs 500 lb and occupies a volume of 29 25 litres. Find	03
		(2) from metal weights 500 to and occupies a volume of 29.25 mets. This the density in Kg/m ³	05
0^2	(a)	A solution of NaCl in water contains 30% NaCl (by mass) at 65° C. The density	07
X .7	(u)	of the solution is 1.25 Kg/ lit. Find the molarity, normality and molality of	07
		solution.	
	(b)	Sodium chloride weighing 600 Kg is mixed with 200 Kg of Potassium	07
		Chloride. Find the composition of mixture in (i) mass % and (ii) mole %.	
		OR	
	(b)	A mixture of gases is obtained having following % composition by weight. The	07
		composition is chlorine $(Cl_2) = 67$, bromine $(Br_2) = 28$ and oxygen $(O_2) = 5$.	
		Using the ideal gas law, calculate (i) composition of the gas by volume and (ii)	
		density of the mixture in gm/ litre at 25 [°] C and 740 mm Hg pressure. Take	
		atomic weights of Cl, Br and O are 35.5, 80 and 16 respectively	
Q.3	(a)	Cracked gas from petroleum refinery has following composition by volume:	07
		45% methane, 10% ethane, 25% ethylene, 7% propane, 8% propylene and 5% n	
		- butane. Find (i) the average molar mass of the gas mixture (ii) the composition	
		by mass and (iii) specific gravity of the gas mixture.	07
	(b)	What is material balance? What is process flow chart? Explain importance of	07
		process flow chart in chemical industry.	
0.2	(a)	UR The spant acid from a nitrating process contains 220(sulphysic acid 260(nitric	07
Q.3	(a)	acid and 21% water by weight. This acid is to be strengthaned by the addition of	07
		concentrated sulphuric acid containing 95% H ₂ SO ₄ and concentrated HNO ₂	
		containing 78% HNO ₂ . The strengthened mixed acid is to contain 40% H ₂ SO ₄	
		and 43% HNO ₂ Calculate the quantities of spent acid and concentrated acids	
		that should be mixed together to yield 1500 Kg of the desired mixed acid	
	(b)	Explain recycling and bypassing with reference to chemical industry with	07
	(0)	suitable diagram.	0.
Q.4	(a)	A solution contains 50% benzene, 30% toluene and 20% xylene by weight at	07
		temperature of 100° C. The vapours are in contact with the solution. Calculate	
		the total pressure and the molar % compositions of liquid and the vapour. The	
		vapour pressure data for different components at 100° C are as follows:	
		Component Benzene Toluene Xylene	
		Vapour press., mm of 1340 560 210	
		Hg	
	(b)	Define the following unit operations with suitable diagram and example:	07
		Distillation, Absorption, Extraction, Crystallization and Evaporation.	

- Q. 4 (a) (1) A compound whose molecular weight is 103 analyses C 81.5; H 4.9; N 04 13.6. What is the formula of compound?
 (2) A solution of naphthalene (C₁₀H₈) in benzene contains 25 mole %. Express 03 the composition of mixture in weight %.
 - (b) The feed to a fractionating system is 30,000 Kg/ hr of 50% benzene, 30%
 (b) The feed to a fractionating system is 30,000 Kg/ hr of 50% benzene, 30% toluene and 20% xylene. The fractionating system consists of two towers no.1 and no.2. The feed enters tower 1. The overhead product from 1 is X Kg/ hr of 95% benzene, 3% toluene and 2% xylene. The bottom product from 1 is feed to 2 resulting in an overhead product of Y Kg/ hr of 3% benzene, 95% toluene and 2% xylene while the bottom from tower 2 is Z Kg/ hr of 1% benzene, 4% toluene and 95% xylene. Find X, Y and Z?
- Q.5 (a) A solution of Potassium dichromate in water contains 13% K₂Cr₂O₇ by weight. 07 1000 Kg of this solution is evaporated to remove some amount of water. The remaining solution is cooled to 20⁰ C. If the yield of K₂Cr₂O₇ is 80%. Calculate the amount of water evaporated. Solubility of K₂Cr₂O₇ is 0.39 Kg mole per 1000 Kg water at 20⁰ C. Take atomic weights of K and Cr is 39 and 52 respectively.
 - (b) A distillation column separates 10, 000 Kg/ hr of 50% benzene and 50% toluene. 07 The product recovered from the top contains 95% benzene while the bottom product contains 96% toluene. The stream entering the condenser from top of the column is 8000 Kg/ hr. A portion of the product is returned to column as reflux and the remaining withdrawn as top product. Find the ratio of the amount refluxed to the product.

OR

- Q.5 (a) Define sensible heat, latent heat, heat of formation, heat of combustion and 07 standard heat of reaction.
 - (b) In crystallization process a solution of CaCl₂ in water contains 62 parts of CaCl₂ 07 per 100 parts of water. Calculate the weight of solution necessary to dissolve 250 Kg CaCl₂.6H₂O crystal at temperature of 25^oC. Solubility of CaCl₂ at 25^oC is 7.38 Kg mole of CaCl₂ per 1000 Kg of H₂O.

OR