Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (New) EXAMINATION – WINTER 2015

Subject Code:2130504 **Date:23/12/2015**

Subject Name: PROCESS CALCULATION

Time: 02.30pm to 05:00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Consider Atomic weight : Si=28, Al=26.98, Mn=54.93, Bo=10.81, Zn=65.39**

			MARKS
Q.1		**Short Questions**	**14**
	1	What is Ideal Gas Law?	
	2	1Atmospheric pressure = ---------- Psi.	
	3	Write down different forms of conversion of temperature.	
	4	What is mass flow rate?	
	5	What is Steady state process?	
	6	Define: Molarity.	
	7	Define: Molality.	
	8	Define: Normality.	
	9	Define: Conversion.	
	10	Define: Yield.	
	11	Define: Specific gravity of a gas	
	12	State that Roult's law	
	13	Find the molecular weight of $KMnO_4$.	
	14	What is the equivalent weight of $Al_2(SO_4)_3$?	
Q.2	**(a)**	Vapour pressure of benzene in the temperature range of 280.65 K (7.5° C) to377.15 K (104°C) can be calculated. By using the following Antoine equation. $\log_{10} p = 6.9057 - \frac{1211.0}{t + 220.8}$ Where, p=vapour pressure in torr (mm Hg) & t=temperature in °C convert the above equation in SI Units.	**03**
	(b)	The diameter and height of a vertical cylindrical tank are 5ft and 6ft 6 inch respectively. It is full up to 75% height with carbon tetrachloride, the density of which is 1.6 kg/litre. Find the mass in kilograms.	**04**
	(c)	In a double effect evaporator plant the second effect is maintain under vacuum of 475 torr (mmHg).Find the absolute pressure in Kgf/cm^2, Kpa, atm, N/m^2, bar.Psi, and mmHg.	**07**
		OR	
	(c)	The analysis of a sample of glass yields 7.8%Na_2O, 7.0%MgO, 9.7%ZnO, 2.0%Al_2O_3, 8.5%B_2O_3 and 65%SiO_2 (by weight).Convert this composition into mole%.	**07**
Q.3	**(a)**	Iron metal weighing 500 lb occupies a volume of 29.25 litres. Calculate the density of Fe in gm/cm^3.	**03**
	(b)	Using Watson equation, calculate latent heat of	**04**

vaporization of acetone at 313 K.
Data: Latent heat of acetone at 329.4 K = 29121 kJ/kmol
Critical temperature of acetone = 508.1 K.

(c) Cracked gas from a petroleum refinery has the following composition by volume methane 45%, Ethane10%, ethylene 25%, Propane 7%, Propylene 8%, n-Butane 5% .Find (a) Average mol.wt.of gas mixture. (b)the composition by weight and (c) Specific gravity of the gas mixture. **07**

OR

Q.3 (a) Explain standard heat of reaction and standard heat of combustion. **03**

(b) Discuss methods of solving material balance problems without chemical reaction. **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 weight. Calculate the quantities of each of the three acids required for blending. **07**

Q.4 (a) In a textile mill, a double-effect evaporator system concentrates weak liquor containing 4 %(by weight) caustic soda to produce a lye containing 25% solids (by weight).Calculate the evaporation of water per 100kg feed in the evaporator. **03**

(b) Discuss uses of recycling and bypassing operation **04**

(c) Soya bean seeds are extracted with hexane in batch reactors. The flacked seeds Contains18.6% oil, 69.0%solids and12.4% moisture. At the end of the extraction process cake is separated from the hexane oil mixture. The cake analysis yields 0.8%oil, 87.7%solids and 11.5% moisture. Find the percentage recovery of oil. All percentage is on wt.basis. **07**

OR

Q.4 (a) Pure methane is heated from 303 K to 523 K at atmospheric pressure. Calculate the heat added per kmol methane using the following data: **03**

$Cp = 19.2494 + 52.1135 \times 10^{-3}T + 11.973 \times 10^{-6} T^2 - 11.3173 \times 10^{-9} T^3$ KJ/(Kmol-K)

(b) Using Antoine equation calculate the vapour pressure of acetic acid at 316 K. **04**
Data: A=6.5127 B= 1533.30 C= -50.8500

(c) What will be the yield of Glauber salt ($Na_2SO_4.10H_2O$) if a pure 32%solution is cooled to 293K (20°C) without any loss due to evaporation? Data: Solubility of Na_2SO_4 in water at 293K (20°C) is 19.4kgper 100kg water. **07**

Q.5 (a) Define the term with reference to air-water humidification operation : **03**
(a) Dry-Bulb Temperature (b) Absolute Humidity
(c) Percentage Humidity

(b) Define the term with reference to air-water humidification operation : (a) Relative Humidity (b) Dew- Point (c) Humid Heat (d) Humid Volume **04**

(c) The dry bulb temperature and dew point of a humid air were found to be 302K (29°C) AND 291K (18°C) **07**

respectively. The barometer reads 100kpa (750torr).
Compute (a) the absolute molal humidity (b) the absolute humidity (c) the percentage RH (d) the percentage saturation (e) the humid heat and (f) the humid volume.

OR

Q.5	**(a)**	Define GCV and NCV for fuels. Give its importance.	**03**
	(b)	Give the names of the equipments used for measuring CV of solid, liquid and gases.	**04**
	(c)	The Orsat analysis of the flue gases from a boiler house chimney gives CO_2: 11.4%, O_2:4.2% and N^2:84.4 %(mole %). Assuming that complete combustion has taken place,(a) calculate the % excess air and (b) find the C:H ratio in the fuel.	**07**

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