Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2130504 Date:23/05/2018

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. **Atomic weights: C:12, H:1,O:16, S:32, Cl:35.5, Na:23,N:14,Mg:24,B:11,Si:28,Al:27,Fe:56,Zn:65**

			MARKS
Q.1	**(a)**	1. What is molality? 2. 1 atmospheric pressure = ----- Psi. 3. What is the equivalent weight of $Al_2 (SO_4)_3$.	**03**
	(b)	In double effect evaporator plant the second effect is maintain under vacuum of 475torr (mmHg).find the absolute pressure in kgf/cm^2, kpa, atm, bar.	**04**
	(c)	A solution of caustic soda in water contains 20%NaOH (by weight) at333K (60^{o}C).The density of the solution is 1.196kg/l.Find the molarity, normality and molality of the solution.	**07**
Q.2	**(a)**	Calculate the weight of 1 m^3 of chlorine gas at a temperature of25^{o}C and a pressure of 745mmHg.	**03**
	(b)	How are you calculate the density of gas mixture?	**04**
	(c)	The analysis of a sample of glass yields 7.8%Na_2O, 7%MgO, 9.7%ZnO, 2.0%Al_2O_3, 8.5%$B_2O_3$and 65%SiO_2 (by wt.).convert this composition into mole%.	**07**
		OR	
	(c)	Cracked gas from a petroleum refinery has the following composition by volumeMethane45%, Ethane10%, Ethylene25%, propane7%, propylene8%, n-Butane5%Find (a) the average Mol.wt. Of gas Mixture. (b) The composition by wt. and (c) Specific gravity of the gas mixture.	**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 1000kg 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**
		OR	
Q.3	**(a)**		**03**

Explain the following terms with reference to chemical process
(1) Process flow sheet
(2) P & I diagram
(3) Degree of freedom

(b) Using Antoine equation, Calculate vapour pressure of Acetaldehyde (C_2H_4O) at 250K **04**
Antoine constants for acetaldehyde are A = 7.134, B = 1600, C = 18.65.

(c) Soybean seeds are extracted with hexane in batch exctractors.The flacked seeds 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% misture.Find the% recovery of oil .All percentage are on wt. basis. **07**

Q.4 **(a)** Calculate the heat of reaction of the following reaction. **03**

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

Data : Component ΔH_f^O cal/ gmol

$NH_3(g)$	-11020
$NO(g)$	21570
$H_2O(g)$	-57796

(b) 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 100 kg feed in the evaporator. **04**

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

OR

Q.4 **(a)** Calculate the heat of formation of glycerol liquid ($C_3H_8O_3$) at 298 K from its elements using Hess's law. Data: Heat of formation of $CO_{2\,(g)}$ = (-393.51 kJ/mol), Heat of formation of $H_2O_{\,(l)}$ = (-285.83 kJ/mol), Heat of combustion of glycerol liquid at 298 K= (-1659.10 kJ/mol). **03**

(b) Define: (1) Heat of reaction (2) Heat of combustion (3) Std. heat of formation (4) Heat capacity. **04**

(c) Temperature of pure Oxygen is raised from 350 to 1500K. calculate the amount of 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

a	b x 10^3	c x 10^6	d X 10^9
26.0257	11.7551	– 2.3426	-0.5623

Q.5 **(a)** Define: Crystallization, Extraction and adsorption. **03**

(b) Define :(1) Absolute humidity (2) Humid Heat (3) Humid volume (4) Percentage humidity. **04**

(c) The dry bulb temperature and dew point of a ambient air were found to be 302K (29 C) and 291K (18^{o}C) respectively. The barometer records 100 kpa a(750torr) **07**

Compute (a) the absolute molal humidity (b) the absolute humidity (c) the % RH (d) the % saturation € the humid heat and (f) the humid volume.

OR

Q.5	**(a)**	Discuss ultimate analysis of coal.	**03**
	(b)	Describe the classification of fuels.	**04**
	(c)	The Or sat analysis of the flue gases from a boiler house chimney gives CO2 11.2%, O2:4.2% and N2 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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