Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III EXAMINATION – SUMMER 2016

Subject Code:130504 **Date:02/06/2016**

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 wt.:**
   O :16, C:12,K:39,H:1,N:14,S:32,Zn:65.4,Cl:35.5,Cu:63.5,Ca:40,Fe:56,Na:23

Q.1 **(a)** 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**

(b) Answer the following: **07**

1)Define: (i) Molarity (ii)Molality (iii)Normality

2) What is Ideal Gas Law?

3)1Atmospheric pressure = ---------- Psi.

4) Write down different forms of conversion of temperature.

5) What is Steady state process?

Q.2 **(a)** In a double effect evaporator plant the second effect is maintain under vacuum of475torr (mmHg).Find the absolute pressure in Kgf/cm^2, Kpa, atm, N/m^2, bar, Psi, and mmHg. **07**

(b) A solution of Caustic soda in water contains 20% NaOH (by weight) at 333K(60^{0}C).The density of the solution is 1.196 kg/l.Find the Molarity, Normality and Molality of the solution. **07**

OR

(b) 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**

Q.3 **(a)** Classify the material balance .Discuss the various methods involved for solving material balance problems without chemical reactions. **07**

(b) 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**

OR

Q.3 **(a)** Discuss in detail about recycling and by passing operations. **07**

(b) 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**

Q.4 **(a)** A Mixture containing 47.5%acetic acid and 52.5% water (by weight) is being separated by the extraction in a counter – current multistage unit. The operating temperature is 297K (24°C) and the solvent used in pure isopropyl ether. Using **07**

the solvent in the ratio of 1.3 kg/kg feed, the final extractoincomposition on a solvent free basis is found to be 82%byweight of acetic acid. The raffinateis found to contain 14% by weight of acetic acid on a solvent free basis. Calculate the percentage of acid of the original feed which remains unextracted.

(b) 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? **07**
Data: Solubility of Na_2SO_4 in water at 293K (20°C) is 19.4kgper 100kg water.

OR

Q.4 **(a)** Temperature of pure Oxygen is raised from 350 to 1500K. Calculate the amount of heat to be supplied for raising the temperature of 1kmoloxygen using the following Cp^0 data. **07**

$$Cp^0 = a + bT + cT^2 + dT^3 \text{ kg/kmol K}$$

a	$bx10^2$	$cx10^6$	$d\ x10^3$
26.0257	11.7551	- 2.3426	-0.5623

(b) A pilot plant reactor was charged with 50kg naphthalene and 200kg (98% by mass) H_2SO_4.The reaction was carried out for 3 hours at 433K.The reaction goes near to completion. The product distribution was found to be 18.6%monosulphate naphthalene (MSN) and81.4% disulphonate naphthalene. Calculate: (a) the quantities of monosulphonate naphthalene (MNS) and disulphonate naphthalene (DNS) products and (b) the analysis of the products. **07**

Q.5 **(a)** The dry bulb temperature and dew point of a humid air were found to be 302K (29°C) AND 291K (18°C) 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. **07**

(b) Define the term with reference to air-water humidification operation : **07**
(a) Dry-Bulb Temperature (d) Relative Humidity (g) Dew Point
(b) Absolute Humidity (e) Humid Heat
(c) Percentage Humidity (f) Humid Volume

OR

Q.5 **(a)** Discuss the brief about Proximate analysis and Ultimate analysis of coal. **07**

(b) 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 %). **07**
Assuming that complete combustion has taken place,(a) calculate the % excess air and (b) find the C:H ratio in the fuel.

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