

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- SEMESTER-III (NEW) EXAMINATION – WINTER 2020****Subject Code:3130508****Date:05/03/2021****Subject Name:Material & Energy Balance Computation****Time:10:30 AM TO 12:30 PM****Total Marks:56****Instructions:**

1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

		Marks
Q.1	(a) Define Fundamental and Derived Units with example	03
	(b) In double effect evaporator plant the second effect is maintain under vacuum of 475torr (mmHg).find the absolute pressure in kpa	04
	(c) A gas contain in a closed vessel at pressure of 121.59 kPa g and 299 K (29 °C) gas heated to temperature of 1273 K (1000 °C) Find the pressure to which a closed vessel should be designed.	07
Q.2	(a) Describe <ol style="list-style-type: none"> (1) Stoichiometric Ratio (2) Stoichiometric Proportion (3) Excess Reactant 	03
	(b) Discuss about By Pass operations	04
	(c) A solution of caustic soda in water contains 20% NaOH (by weight) at 333 K. The density of the solution is 1.196kg/l. Find the molarity, normality and molality of the solution	07
Q.3	(a) Explain the methods for solving problems of material balance without chemical reactions	03
	(b) A combustion reactor is fed with 50 kmol/ of butane and 2100kmol/h air calculate the % excess air used.	04
	(c) It is required to make 1000 kg mixed acid containing 60% H ₂ SO ₄ , 32% HNO ₃ and 8% water by blending (i) the spent acid containing 11.3 % HNO ₃ , 44.4% H ₂ SO ₄ and 44.3 % H ₂ O. (ii) Aqueous 90% HNO ₃ and (iii) aqueous 98 % H ₂ SO ₄ . All percentages are by mass. Calculate the quantities of each of the three acids required for blending	07
Q.4	(a) Define : Drying, Evaporation, crystallization	03
	(b) (A) In Manufacture of chlorine, feed containing HCL acid gas and air are fed to an oxidizer the product gases leaving the oxidizer are found to contain 13.2 % HCL, 6.3% O ₂ , 42.9% N ₂ , 30% CL ₂ , 7.6% H ₂ O Calculate A) The percent excess air used. B) The composition by weight of gases entering the oxidizer	04

- (c) Soybean seeds are extracted with hexane in batch extractors. The flaked 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 % moisture. Find the % recovery of oil .All percentage is on weight basis **07**
- Q.5** (a) Describe Importance of energy balance in chemical industry. **03**
- (b) Define material balance and explain methods solving material balance without chemical reaction. **04**
- (c) Temperature of pure Oxygen is raised from 350 to 1500 K. calculate the amount of heat to be supplied for raising the temperature of 1 kmol oxygen using the following Cp data **07**
 $C_{p0} = a + bT + cT^2 + dT^3$ KJ/ (Kmol. K)

Gas	a	b x 10 ³	c x 10 ⁶	d x 10 ⁹
O ₂	26.0257	11.7551	-2.3426	-0.5623

- Q.6** (a) Define the following terms: **03**
 (1) Heat of formation
 (2) Heat of combustion
 (3) Heat of reaction
- (b) In Production of SO₃, 100 kmol of SO₂, And 200 kmol of O₂ are fed to a reactor. The Product stream is found to contain 80 kmol SO₃. Find the Percentage conversion of SO₂ **04**
- (c) Pure methane gas is heated from 303K to 523K at atmospheric pressure. Calculate the heat added per kmole methane using Cp⁰ data given below **07**
 $C_{p0} = a + bT + cT^2 + dT^3$ KJ/ (Kmol. K)

Gas	a	b x 10 ³	c x 10 ⁶	d x 10 ⁹
CO ₂	19.2494	52.1135	11.973	-11.3173

- Q.7** (a) In manufacture of acetic acid by oxidation of acetaldehyde, 100kmol of acetaldehyde is fed to a reactor per hour. The product leaving the reactor contain 14.81% acetaldehyde, 59.29% acetic acid , and rest of oxygen. Find percentage conversion of acetaldehyde **03**
- (b) The GHV(gross heating value) of gaseous n- butane is 2877.40 kj/ mol at 298 K. calculate its NHV (net heating value) in KJ/kg **04**
- (c) Explain Air Requirement for fuel and used method of theoretical oxygen, theoretical, air Excess air **07**
- Q.8** (a) In Production of SO₃, 100 kmol of SO₂, And 200 kmol of O₂ are fed to a reactor. The Product stream is found to contain 80 kmol SO₃. Calculate the composition of the product stream on mole basis **03**
- (b) Crude oil is analyzed to contain 87% carbon , 12.5% hydrogen and 0.5 % sulphur calculate net calorific value of crude oil at 298 K. **04**
- (c) Discuss about proximate and ultimate analysis of fuel **07**
