

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III(NEW) EXAMINATION – SUMMER 2023****Subject Code:3133606****Date:24-07-2023****Subject Name:Fundamentals of Material & Energy Balance Calculations****Time:02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

	Marks
Q.1 (a) Define: 1) Material Balance 2) Process 3) Property	03
(b) Explain the following quantities with their SI units: i) Force ii) Energy	04
(c) Explain extensive & intensive properties with their examples.	07
Q.2 (a) What are the methods to express composition of mixtures & solution?	03
(b) Calculate the kilograms of ethane in 210 kmol?	04
(c) Calculate the equivalent weights of: 1) H_3PO_4 2) $CaCO_3$	07
OR	
(c) Write a short note on: 1) Normality 2) Molarity 3) Molality.	07
Q.3 (a) Calculate the kilogram atoms of carbon which weighs 36 kg.	03
(b) Define: i) Molarity ii) Amagat's Law iii) Normality iv) Dalton's Law	04
(c) A solution of H_2SO_4 has molarity of 11.24 & molality of 94. Calculate density of solution?	07
OR	
Q.3 (a) Derive: $PV=nRT$.	03
(b) Write a short note on: 1) Absolute Humidity 2) Relative Humidity	04
(c) Derive: $Pressure\% = Mole\% = Volume\%$	07
Q.4 (a) Derive: $\rho_{mix} = (PM_{avg})/RT$	03
(b) Explain the concept of yield with suitable example.	04
(c) A gas mixture contains 0.274 kmol of HCl, 0.337 kmol of N_2 and 0.089 kmol of O_2 . Calculate: (a) Average molecular weight of gas (b) Volume occupied by this mixture at 405.3 KPa and 303 K ($30^\circ C$).	07
OR	
Q.4 (a) Define: 1) Critical Temperature 2) Critical Pressure	03
(b) Explain Van der Waal's equation of state.	04
(c) A certain quantity of a gas contained in a closed vessel of volume $1\ m^3$ at a temperature of 298 K ($25^\circ C$) and pressure of 131.7 kPa is to be heated such that the pressure should not exceed 303.98 kPa. Calculate the temperature of gas attained.	07
Q.5 (a) Define: 1) Limiting Reactant 2) Stoichiometry 3) % Excess	03
(b) Define: i) Law of Conservation of Mass ii) Heat Capacity iii) Enthalpy	04
(c) Explain the steps to be followed while taking material balance with chemical reaction and without chemical reaction	07

OR

- Q.5 (a)** What is the significance of recycle operation? **03**
- (b)** A coke is known to contain 90% carbon and 10% non-combustible ash (by weight): $C + O_2 = CO_2$ **04**
- a). Find the moles of oxygen theoretically required to burn 100 kg of coke completely. b). If 50% excess air is supplied, find the analysis of the gases at the end of the combustion?
- (c)** Soya bean seeds are extracted with the hexane in batch extractors. The flaked seeds are found to contain 18.6% oil, 69% solids, 12.4% moisture (by weight). At the end of the extraction process, cake is separated from hexane-oil mixture. The cake is analyzed to contain 0.8% oil, 87.7% solids and 11.5% moisture (by weight). Find the percent recovery of oil. **07**
