

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-IV EXAMINATION – SUMMER 2016

Subject Code:140504**Date:10/06/2016****Subject Name:Fundamental Chemical Engineering Calculations & Stoichiometry****Time:10:30 AM to 01:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Define the following terms: **07**
- 1) Conversion
 - 2) Yield
 - 3) Selectivity
 - 4) Limiting component
 - 5) Excess component
- (b)** Explain the terms: **07**
- 1) Relative Humidity
 - 2) Dew point
 - 3) Humid heat
 - 4) Dry – bulb temperature
 - 5) Wet – bulb temperature
- Q.2 (a)** Explain recycling and bypassing with suitable diagram. **07**
- (b)** Define Sensible heat, Latent heat, Heat of formation, Heat of combustion and Standard heat of reaction. **07**
- OR**
- (b)** Carbon dioxide weighing 1.10 kg occupies a volume of 33 liters at 300⁰K. **07**
Calculate the pressure using the van der waals equation of state.
 $a = 3.60 \text{ (m}^3\text{)}^2 \text{ kPa/(kmol)}^2$ and
 $b = 4.3 \times 10^{-2} \text{ m}^3 / \text{kmol}$ for CO₂
- Q.3 (a)** Explain the following terms. **07**
- 1) Process flow sheet.
 - 2) Degree of freedom.
 - 3) Endothermic and exothermic reaction.
- (b)** With a neat sketch show material balance for following unit operation. **07**
- 1) Extraction 2) Evaporation
- OR**
- Q.3 (a)** With a neat sketch show material balance for following unit operation. **07**
- 1) Distillation column
- (b)** The carbon monoxide is reacted with hydrogen to produce methanol. Calculate **07**
from the reaction.
- a) The stoichiometric ratio of H₂ to CO
 - b) Kmol of CH₃OH produced per kmol CO reacted.
 - c) The weight ratios of CO to H₂ if both are fed to reactor in stoichiometric proportion.
 - d) The quantity of CO required to produce 1000 kg of CH₃OH
- Q.4 (a)** Differentiate between fundamental units & derived units. Define 1) Raoult's **07**
Law 2) Dalton's Law

- (b) Describe the methods of solving material balance problems without chemical reactions. **07**

OR

- Q.4** (a) Explain BOD, COD, pH and Specific gravity. **07**
(b) A dryer is used to dry 100 kg/hr wet solids from 20 % to 1 % moisture by weight by hot air. The fresh air containing 0.02 kg water vapor per kg dry air is available at 303 °K (30 °C) and 101.325 kPa. Air leaving the dryer is found to contain 0.1 kg water vapor per kg dry air. If the recycle ratio is maintained at 3 kg dry air in recycle air per kg dry air in fresh air. Calculate the volumetric flow rate of fresh air assuming the molecular weight of fresh air to be 28.8. **07**

- Q.5** (a) Explain the methods of expressing the composition of mixtures and solutions. **07**
(b) Describe relationship between partial pressure, mole fraction of component gas to total pressure. **07**

OR

- Q.5** (a) Prove $C_p - C_v = R$ **07**
(b) A stream of nitrogen flowing at a rate of 100 kmol/h is heated from 303 °K (30 °C) to 373 °K (100 °C). Calculate the heat that must be transferred. **07**
Data : C_p^0 for nitrogen
 $= 29.5909 - 5.141 \times 10^{-3} T + 11.1829 \times 10^{-6} T^2 - 4.968 \times 10^{-9} T^3$
