

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III • EXAMINATION – SUMMER • 2014****Subject Code: 130504****Date: 28-05-2014****Subject Name: Process Calculation****Time: 02.30 pm - 05.30 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) List the various systems of units and give the example of any four derived units in each system of units. **07**
- (b) Explain Ideal gas law, Dalton's law and Raoult's law. **07**
- Q.2** (a) A continuous distillation column is used to regenerate solvent for use in a solvent extraction unit. The column treats 200 kmol/hr or a feed containing 10 mol % ethyl alcohol and the rest water. The overhead product is 89 mol % alcohol and the bottom product is 0.3 mol % alcohol. The overhead is sent to the extraction unit and bottom is waster. What is the daily requirement of make- up alcohol in the solvent extraction unit? **07**
- (b) Explain the material balance of extractor. **07**
- OR**
- (b) Explain the material balance of crystallizer. **07**
- Q.3** (a) Write the general material balance equation and explain the concept of limiting and excess reactant. **07**
- (b) Calculate the molar quantity of all the product materials when 1 kg-atom of sulfur is burned with 20% excess air and will produce 95% SO₂ and remaining SO₃. **07**
- OR**
- Q.3** (a) Calculate the enthalpy of the tank filled with liquid having following data: **07**
Pressure inside the tank=7000 kPa, volume of liquid=7.0685 m³
Volume of tank = 14.137 m³, Internal energy of liquid=5.3 * 10⁹ J
- (b) The molal heat capacity of CO is given by $C_p = 26.586 + 7.582 \times 10^{-3} T - 1.12 \times 10^{-6} T^2$ where C_p is in kJ/kmol K and T is in K. Calculate the meanmolal heat capacity in the temperature range of 500-1000 K. **07**
- Q.4** (a) Define: Sensible heat, Latent heat, Heat of reaction, Heat of solution, Adiabatic reaction. **07**
- (b) Wood containing 40% moisture is dried to 5% moisture. What mass of water in kilograms is evaporated per kg of dry wood? **07**
- OR**
- Q.4** (a) Explain the concept of recycle, bypass and purge stream. **07**
- (b) Calculate the yield of Na₂SO₄.10H₂O if a pure 32% solution is cooled to 20 °C without any loss due to evaporation. Take solubility of Na₂SO₄ in water at 20 °C is 19.4 kg/100 kg water. **07**
- Q.5** (a) Explain proximate analyses. **07**
- (b) Crude oil is found to contain 87.1% carbon, 12.5% hydrogen and 0.4% sulfur (by mass). Its GCV at 25 °C is measured to be 45071 kJ/kg oil. Calculate its NCV at 25 °C. Latent heat of water vapor=2442.5 kJ/kg **07**
- OR**
- Q.5** (a) Explain ultimate analyses. **07**
- (b) The orsat analysis of the flue gases from a boiler house chimney gives CO₂=11.4%, O₂=4.2% and H₂=84.4%(mole %). Assuming that complete combustion has taken place, calculate the % excess air. **07**
