Enrolment No.

Date: 28-05-2014

Total Marks: 70

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GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-III • EXAMINATION – SUMMER • 2014

Subject Code: 130504

Subject Name: Process Calculation

Time: 02.30 pm - 05.30 pm

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 07 each system of units.
 - (b) Explain Ideal gas law, Dalton's law and Raoult's law.
- Q.2 (a) A continuous distillation column is used to regenerate solvent for use in a solvent 07 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?
 - (b) Explain the material balance of extractor. 07

OR

- (b) Explain the material balance of crystallizer.
- Q.3 (a) Write the general material balance equation and explain the concept of limiting 07 and excess reactant.
 - (b) Calculate the molar quantity of all the product materials when 1 kg-atom of sulfur 07 is burned with 20% excess air and will produce 95% SO₂ and remaining SO₃.

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 m^3 Volume of tank = 14.137 m³, Internal energy of liquid= $5.3 \times 10^9 \text{ J}$
 - (b) The molal heat capacity of CO is given by $C_P=26.586+7.582*10^{-3} \text{ T} 1.12*10^{-6}$ 07 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.
- Q.4 (a) Define: Sensible heat, Latent heat, Heat of reaction, Heat of solution, Adiabatic 07 reaction.
 - (b) Wood containing 40% moisture is dried to 5% moisture. What mass of water in 07 kilograms is evaporated per kg of dry wood?

OR

- Q.4 (a) Explain the concept of recycle, bypass and purge stream.
 - (b) Calculate the yield of Na₂SO₄.10H₂O if a pure 32% solution is cooled to 20 °C 07 without any loss due to evaporation. Take solubility of Na₂SO₄ in water at 20 °C is 19.4 kg/100 kg water.
- **Q.5** (a) Explain proximate analyses.
 - (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

OR

- **Q.5** (a) Explain ultimate analyses.
 - (b) The orsat analysis of the flue gases from a boiler house chimney gives $CO_2 = 07$ 11.4%, $O_2 = 4.2\%$ and $H_2 = 84.4\%$ (mole %). Assuming that complete combustion has taken place, calculate the % excess air.
