Code No: NR210803 **NR**

II B.Tech I Semester Supplementary Examinations, May 2005
MATERIALS AND ENERGY BALANCE
(Chemical Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Make the following conversions:
   (a) 294 g/1 H_2SO_4 to normality.
   (b) 5N H_3PO_4 to g/1.
   (c) 54.75 g/1 HCl to molarity.
   (d) 3M K_2SO_4 to g/1.
2. (a) Calculate the volume occupied by 13.6 kg of chlorine at a pressure 743 mm Hg and 21.1^0C.
   (b) Calculate the weight of 3 cu.m of water vapor, measured at a pressure of 15.5 mm Hg and 23^0C.
3. Write short notes on:
   (a) Cox chart and its applications.
   (b) Duhrings chart and its application.
   (c) Critical properties.
   (d) Reduced conditions.
4. A mixture of benzene and dry air at a temperature of 30^0C and a pressure of 750 mm Hg is found to have a dew point of 15^0C. Vapour pressure of benzene at 30^0C is 118.5 mm Hg. Calculate
   (a) Percentage by volume of benzene.
   (b) Moles of benzene per mole of air.
   (c) Weight of benzene per unit weight of air.
5. (a) The reaction between ethylene and hydrogen bromide to form ethyl bromide is carried out in a continuous reactor. The product stream, on analysis, is found to contain 50 % C_2H_5Br and 33 % HBr (by volume). The feed to the reactor contains only ethylene and hydrogen bromide. Calculate :
      i. the fractional conversion of the limiting reactant.
      ii. The percentage by which the other reactant is in excess.
   (b) It is desired to have a mixed acid containing 39% HNO_3, 42% H_2SO_4 and 19% H_2O (by weight). Nitric acid of 68.3% (by weight) is readily available, Calculate

i. The required strength of Sulphuric acid to obtain the above mixed acid.
ii. The weight ratio of Nitric acid to Sulphuric acid to be mixed.

6. (a) Calculate the excess air used in a furnace when the flue gas orsat analysis is CO_2 8.2, O2 9.9, CO 0.1, H_2 0.4 and N_2 81.4 (all in percent).
   (b) A flue gas containing 97% (vol.) methane and 3% (vol.) nitrogen is burned in a boiler furnace with 200% excess air. Eighty five percent of methane goes to CO_2, 10% to CO and 5% remains unburnt. Calculate the composition of stack gas.

7. (a) Write about the following:
   i. Kopp's rule.
   ii. Trouton's rule.
   iii. Kistyakowsky equation for non-polar liquids.
   (b) Calculate the heat of vaporization in cal/g of carbon tetrachloride at its normal boiling temperature (76.7^0C) by the following methods:
   (c) From the equation of Kistyakowsky (b) Trouton's rule

8. Carbon monoxide gas is burned at constant pressure with 100% excess air. The reactants enter at 25^0C and the exhaust gases leave the reaction chamber at 1200^0C. Estimate the heat loss from the reaction chamber
   Standard heat of combustion of CO = -282,900 J/mol
   $Cp = a + b\,T + c\,T^2$ Cp in J/gmol - k, T in K

	a	b x 10^3	C x 10^6
CO_2	26.75	42.26	-14.25
N_2	27.02	5.81	- 0.29
O_2	25.29	13.25	- 4.20

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