[3 Hours] [Total Marks: 80]

(1) Q.1 is compulsory.
(2) Attempt any 3 from the remaining 5 questions.
(3) Use graph paper, if required.
(4) Assume suitable data if required and justify the same

Q1:A. Sodium chloride weighing 200 kg is mixed with 600 kg potassium chloride. Calculate the composition of the mixture in weight percent and mole percent. [5]

B. The available nitrogen (N) in an urea sample is found to be 45%(weight basis). Calculate actual urea content in the sample. [5]

C.Explain effect of temperature on heat of reaction. [5]

D. Write outline of a procedure for material balance calculations. [5]

Q2A.500 kg of mixture of benzene and toluene containing 50 mole % benzene is distilled to get an overhead product containing 95 mole percent benzene and a residue containing 90 mole percent toluene. Calculate weights of toluene and benzene in feed, distillate and residue. [10]

B.The feed water to a reverse osmosis plant contains 5000 ppm dissolved solids. The feed to product ratio is 4:3(weight basis). The treated water (product) leaving the plant contains 600 ppm solids. Find the dissolved solids content of the concentrated stream(rejected stream). [10]

Q3:A.Calculate the consumption of 96% NaCl and 93 % $H_2SO_4$to produce 500 kg HCl if conversion is 92% . The reaction takes place as: $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2\ HCl$ [10]

B.A furnace is fired with a fuel oil. The Orsat analysis of the flue gases is 10.6%CO_2, 6% O_2 and the rest N_2 by volume. Find C:H ratio in the fuel oil, assuming that the fuel oil does not content any nitrogen. [10]

Q4:A. A dryer is used to dry 100 kg/h of wet solids from 20% to 1% moisture(by Wt) by hot air. The fresh air contains 0.02 kg water per kg dry air. It is available at 303 K and 101.325 kPa. Air leaving the dryer is found to contain 0.1 kg water vapour per kg dry air. If the recycle ratio is maintained at 3 kg dry air in the recycle air per kg dry air in the fresh air, calculate the volumetric flow rate of fresh air assuming the molecular weight of fresh air to be 28.8. [10]

B. Explain (a)Limiting reactant(b) Percent excess(c)Conversion(d) Yield(e) Selectivity [10]

Q5:A.Calculate standard heat of formation of phenol crystal (C_6H_5OH) at 298.15 K using following data. [10]

Std.heat of formation of $CO_2(g)$= -393.51 kj/mol

Std. heat of formation of $H_2O(l)$ = -285.83 kj/mol

Std. heat of combustion of phenol crystals= -3053.25kj/mol

B.Methane gas is heated from 303 K to 523 k at atmospheric pressure. Calculate the heat added per kmol methane using Cp^0 data given below. [10]

$Cp= a+ bT+dT^2+dT^3$, kj/kmol.k

Gas	a	$bx10^3$	$C\ x10^6$	$dx10^9$
methane	19.2494	52.1135	11.973	-11.3173

Q6:A.Explain concept of limiting and excess reactant [5]

C.Explain recycle ratio and purge ratio. [5]

D.Differentiate between proximate and ultimate analysis of fuel. [5]

E.Explain Hess's law of constant heat summation. [5]
