CBCS SCHEME

USN | | | | | | | | | | |

18BT41

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
Stoichiometry

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain Dalton's law, Amagats law, Normality, Molarity and Molality. **(10 Marks)**

b. A gas mixture contains 0.274 kmol of HCl, 0.337 kmol of N_2 and 0.089 kmol of O_2. Calculate (i) Average molecular weight of the gas and (ii) Volume occupied by this mixture at 405.3 KPa and 303 K(30°C). **(10 Marks)**

OR

2 a. With outline diagram, explain the generalized unit operation process and material balance for distillation and extraction. **(08 Marks)**

b. Calculate the available nitrogen content of solution having 30% urea (NH_2CONH_2), 20% ammonium sulphate ($(NH_4)_2SO_4$) and 20% ammonium nitrate (NH_4NO_3). **(08 Marks)**

c. 20 g of Caustic soda is dissolved in water to prepare 500 ml of solution. Find the molarity and molality of the solution. **(04 Marks)**

Module-2

3 a. An evaporator in fed with 15000 kg/h of a solution containing 10% NaCl, 15% NaOH and rest water. In the operation, water is evaporated and NaCl is precipitated as crystals. The thick liquor leaving the evaporator contains 45% NaOH, 2% NaCl and rest water. Calculate (i) kg/h water evaporated (ii) kg/h salt precipitated (iii) kg/h thick liquor.
Note : All % are given by mass. **(10 Marks)**

b. The feed to a continuous fractionating column analysis by weight 28% by mass benzene and 72% by mass toluene. The analysis of the distillate shows 52 weight percent benzene and 5 weight percent benzene was found in the bottom product. Calculate the amount of distillate and bottom product per 1000 kg of feed per hour. Also calculate percent recovery of benzene. **(10 Marks)**

OR

4 a. Explain calorific value, net calorific value, grass calorific value, theoretical oxygen and theoretical air. **(10 Marks)**

b. Calculate the Net Calorific Value (NCV) at 298 K (25°C) at a sample of fuel oil having C/H ratio 9.33 (by weight) and containing sulphur to the extent of 1.3 % by weight.
Data : The GCV of the fuel oil at 298 K (25°C) $\Longrightarrow$ 41785 kJ/kg.
Latent heat of water vapour at 298 K (25°C) = 2442.5 kJ/kg **(10 Marks)**

Module-3

5 a. Explain (i) Bypass (ii) Recycle (iii) Perge (iv) Dew point **(08 Marks)**

b. Ethylene oxide is produced by oxidation of ethylene. 100 kmol of ethylene are fed to the reactor and the product is found to contain 80 kmol ethylene oxide and 10 kmol CO_2. Calculate (i) the percent conversion of ethylene and (ii) the percent yield of ethylene oxide. **(12 Marks)**

OR

6 a. Explain the following :
(i) Limiting reactant
(ii) Excess reactant
(iii) Conversion
(iv) Yield **(08 Marks)**

b. In manufacture of acetic acid by oxidation of acetaldehyde, 100 kmol of acetaldehyde is fed to a reactor per hour. The product leaving the reactor contains 14.81% acetaldehyde, 59.26% acetic acid and rest oxygen (on mole basis). Find the percentage conversion of acetaldehyde. **(12 Marks)**

Module-4

7 a. Explain the general energy balance procedure and effect of temperature on heat of reaction. **(10 Marks)**

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.
Data : C_P° for nitrogen $= 29.5909 - 5.141\times10^{-3}T + 11.1829\times10^{-6}T^2 - 4.968\times10^{-9}T^3$. **(10 Marks)**

OR

8 a. Explain the following :
(i) Heat of reaction
(ii) Heat of formation.
(iii) Heat of combustion.
(iv) Hess's law. **(10 Marks)**

b. Chlorinated diphenyl is heated from 313 K (40°C) to 533 K (280°C) in an indirectly fired heater at the rate of 4000 kg/h. Calculate the heat required to be added to the fluid in the heater. The heat capacity of the fluid in this temperature range is given by equation below :
$C = 0.7511 + 1.465\times10^{-3}T$, (kJ/kg.K) where T is in K. **(10 Marks)**

Module-5

9 a. Explain the role of bioprocess engineer in the field of biotechnology industry. **(10 Marks)**

b. Explain the role of generalized process flow sheets in bioprocess industries, with a suitable example. **(10 Marks)**

OR

10 Write notes on the following:
a. Specific growth rate and yield in manufacture of Penicillin. **(10 Marks)**
b. Stoichiometry of microbial growth and product formation. **(10 Marks)**

* * * * *