(3 Hours) **(Total Marks: 80)**

N.B.: 1. Question No.1.iscompulsory.

2. Attempt any three questions out of the remaining five questions.

3. Assume suitable data wherever required.

4. Figures to the right indicates full marks.

Q.1] Solve any four 20

(a) Explain Tray efficiency in brief.

(b) Explain the Adsorption Isotherm

(c) Write short note on Binodal Curve

(d) Discuss the industrial applications of leaching operation.

(e) Osmotic equilibrium in reverse osmosis processes.

(f) Explain the Miers supersaturation theory.

Q.2] (a) A mixture of benzene and toluene containing 40 mole% benzene is to be separated to give a product of 90 mole% of benzene from top and bottom product with not more than 10 mole% benzene. Using an average value of 2.4 for the volatility of benzene relative to toluene, calculate the number of theoretical plate required at total reflux. 10

(b) Discuss the single stage leaching and derive the equations for single stage leaching. 10

Q.3] (a) If 100kg of solution of acetic acid (C) and water (A) containing 30% acid is to be extracted three times with isopropyl ether (B) at 20ºC,using 40kg of solvent in each stage, determine the quantities and compositions of the various streams. How much solvent would be required if the same final raffinate concentration were to be obtained with one stage? The equilibrium data at 20ºC is given below. 12

Water Layer			Isopropyl Ether layer		
Wt % Acetic acid, 100x	Water	Isopropyl ether	Acetic acid, 100y*	Water	Isopropyl ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4

6.42	91.7	1.9	1.93	1.0	97.1
13.30	84.4	2.3	4.82	1.9	93.3
25.50	71.1	3.4	11.40	3.9	84.7
36.70	58.9	4.4	21.60	6.9	71.5
44.30	45.1	10.6	31.10	10.8	58.1
46.40	37.1	16.5	36.20	15.1	48.7

(b) Explain the azeotropes in detail. 8

Q.4] (a) Experiments on decolourisation of oil yielded the following equilibrium relationship: 12

$$y = 0.5\, x^{0.5}$$

Where, y = g colour removed/ g adsorbent.

x = colour in oil, gm of colour/ 1000 gm of colour free-oil.

100 kg oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of adsorbent. Calculate the % colour removed if all 25 kg of adsorbent is used in one step.

(b) Discuss the terms i) Reflux ratio, ii) Optimum reflux ratio (iii) Minimum reflux ratio. 8

Q.5] (a) Calculate the yield of $MgSo_4 7H_2O$ crystals when 1000kg saturated solution of $MgSo_4$ at 353K is cooled to 303K assuming 10% of water is lost by evaporation during cooling. 10

Given Data: Solubility of $MgSo_4$ at 353K = 64.2 kg/100kg water

Solubility of $MgSo_4$ at 303K = 40.8 kg/100kg water

(b) A batch of water containing residual chlorine at a concentration of 12 ppm is to be treated with activated carbon at 25ºC to reduce the chlorine concentration to 0.5 ppm. Estimate the minimum mass of carbon per unit volume of water which can be used. 10

The equilibrium distribution coefficient = c^*/X = 0.8 (kg Cl_2/m^3 liquid)/(kg Cl_2/kg Carbon).

Q.6] Solve any four. 20

(a) Write short note on Swenson walker crystallizer.

(b) Explain in brief Ion exchange process.

(c) Write short note on Nano filtration.

(d) Explain factors involved in choice of solvent in extraction

(e) Write short note on simple distillation.