22609

23124

3 Hours / 70 Marks Seat No. | | | | | | | | |

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define the following terms

i) Raffinate

ii) Extract

b) Write any two effect of impurities on crystal formation.

c) State Raoult's law with mathematical equation.

d) Differentiate between distillation and extraction. (any two points)

e) Name any four types of packings in column.

f) Write any two methods of attaining supersaturation.

g) Define critical moisture content and bound moisture content.

Marks

2. Attempt any THREE of the following: 12

a) Draw rate of drying curve under constant drying conditions and mention on it.

i) Critical moisture content.

ii) Equilibrium moisture content.

b) Derive Rayleighs equation for differential distillation.

c) Explain construction and working of agitated tank crystallised with neat sketch.

d) Write selection criteria of solvent for extraction (any four points)

3. Attempt any THREE of the following: 12

a) Explain construction and working of rotary dryer with neat sketch.

b) Explain briefly boiling point diagram.

c) A mixture of methanol and water containing 50 mol% methanol is distilled to obtain a distillate containing 95 mol% methanol and residue containing 7 mol% methanol. If feed is admitted at rate of 10,000 $\frac{\text{kmol}}{\text{hv}}$ calculate molal flow rate of distillate and residue.

d) Differentiate between absorption and distillation. (any four points)

Marks

4. Attempt any THREE of the following: **12**

a) Describe mixer-settler assembly for counter current extraction with neat sketch.

b) A solution of $NaNO_3$ in water contains 40% $NaNO_3$ by weight at 310 K. Calculate the yield of $NaNO_3$ crystals that may be obtained when temperature is reduced to 280 K.

Data : Solubility of $NaNO_3$ in water at 280 K is 80.2 kg $NaNO_3$ per 100 kg water.

c) Define diffusion. Also state Fick's Law of diffusion with mathematical expression.

d) Explain in brief on valve plate with neat sketch.

e) Wet solids are to be dried from 70% to 5% moisture (wet basis). Calculate the amount of moisture to be evaporated per 100 kg of dried product.

5. Attempt any TWO of the following: **12**

a) Write characteristics of tower packing. (any six points)

b) Explain construction and working of tray dryer with neat sketch.

c) A mixture of benzene and toluene containing 60 mole% benzene is to be separated to give a product of 95 mole % benzene and bottom product containing 10 mole% benzene. The feed enters the column at its bubble point. It is proposed to operate the column with reflux ratio of 2.5. It is required to find the number of theoretical plates needed and position of feed plate.
The vapour-liquid equilibrium data are given as below.

x	0	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.13	0.21	0.375	0.5	0.6	0.7	0.77	0.83	0.9	0.95	1.0

Marks

6. Attempt any TWO of the following: **12**

a) Explain construction and working Swenson Walker crystallier with neat sketch.

b) The vapour pressure of n-hexane and n-octane are given below. Obtain an empirical relation between y and x for this system at constant pressure of 101.3 kpa.

T, ºC	68.7	79.4	93.3	107.2	121.1	125.6
T, ºK	341.7	352.4	366.3	380.2	394.1	398.6
P^o_{Hexane}, Kpa	101.3	136.6	197.3	283.9	399.9	455.9
P^o_{Octane}, Kpa	16.1	23.1	37.1	57.8	87.2	101.3

With the help of empirical equation generate vapour-liquid equilibrium data and construct x-y plot.

c) Derive the equation of q-line

$$y = \frac{-q}{1-q}x + \frac{x_f}{1-q}$$