Total number of printed pages – 3

Sixth Semester Regular / Back Examination – 2015
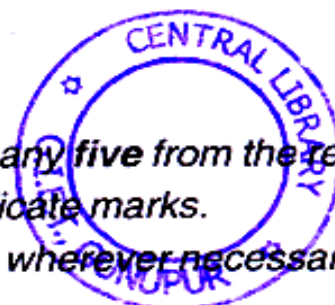
MASS TRANSFER - II

BRANCH : CHEM

QUESTION CODE : J 280

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any five from the rest.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.

1.   Answer the following questions :   2×10

(a)   What are the factors affecting mass transfer rates in liquid-liquid extraction ?

(b)   What is fractional extraction ? Give an example.

(c)   What is selectivity ? Mention its value at which no separation is possible.

(d)   Name the factors involved in the choice of a solvent for a leaching operation.

(e)   Is desiccant an adsorbent ? Justify.

(f)   What do you understand by "mass transfer zone" in case of adsorption ?

(g)   Illustrate the reactions involved in demineralization of water by ion exchange.

(h)   For non-hygroscopic materials, equilibrium moisture content is _____ at all temperatures and humidities.

    (i)   0

    (ii)   1

    (iii)   > 1

    (iv)   None of these

(i)   With a neat plot, explain the types of moisture content.

(j)   What is the range of slopes of rotary dryers and rotary kilns ?

P.T.O.

2. 120 kg/hr of 50-50 acetone-water solution is to be reduced to 10 % acetone using 28 kg/hr of TCE as solvent in a multistage counter-current extraction operation at 25ºC. Calculate the number of stages required. The equilibrium data at 25ºC for the system of TCE-water is as follows :　　　　　　　　　　10

Mutual solubility data (concentration by weight) :

TCE	Water	Acetone
99.89	0.11	0.0
84.65	0.59	14.76
70.36	1.43	28.21
60.06	2.11	37.83
43.88	5.0	51.12
26.39	15.35	60.26
20.71	19.31	59.88
9.63	35.38	54.99
2.18	55.97	41.85
1.02	71.80	27.18
0.44	99.56	0.0

Data for tie lines :

Raffinate phase			Extract phase		
TCE	Water	Acetone	TCE	Water	Acetone
0.52	93.52	5.96	90.93	0.32	8.75
0.68	85.35	13.67	78.32	0.9	20.78
1.00	73.0	26.0	60.85	2.09	37.06
1.1	69.35	29.54	55.48	2.85	41.67
2.1	57	40.9	40.0	6.05	53.95
6.52	41.7	51.78	26.76	13.4	60.34

3. Crushed oil-seeds containing 50 % oil (by weight) is to be extracted at the rate of 3920 kg/hr using 112 kg/min of n-hexane containing 4.5 % oil (by weight) as the solvent. A counter current two stage extraction system is employed. The oil-seeds will retain 1 kg of solution per kg of oil-free cake. Estimate the percent recovery of oil (based on original feed) obtained under the above conditions.　　　　10

4. The decolourization of an oil sample follows the equilibrium relation :

$$y = 0.6\,x^{0.45},$$

where,

y = gm of colour removed / gm of adsorbent and

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

100 kg of oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of the adsorbent. Calculate the % of colour removed if all 25 kg adsorbent is used in one step. **10**

5. 5 kg of a wet solid in slab form contains 50 % moisture on wet basis. The slab dimension is $600 \times 900 \times 75$ mm³. The equilibrium moisture content is 5 % of the total weight when in contact with air of 20°C and 20% humidity. The drying rate is given below for contact with air of the above quality at a definite velocity. Drying is from one face only. How long will it take to dry the slab to 15 % moisture content wet basis ? **10**

Data :

Wet slab, kg	9.1	7.2	5.3	4.2	3.3	2.8	2.5
Drying rate	4.9	4.9	4.4	3.9	3.4	2.0	1.0

6. (a) Discuss with a neat diagram, the construction and working of rotating disk columns used for liquid-liquid extraction operation. **5**

   (b) Discuss with a neat diagram, the construction and working of a rotocel extractor used for solid-liquid leaching operation. **5**

7. (a) Give the relationships for any two different types of gas adsorption isotherms. **6**

   (b) What are the characteristics and operating parameters of drum dryers ? **4**

8. Write short notes on any **two** : **5×2**

   (a) Bimodal solubility curve

   (b) Shanks system

   (c) Characteristics of ion-exchange resins

   (d) Spray dryer.