Registration No. : | | | | | | | | | | |

Total number of printed pages – 4

B. Tech.
PCCH 4306

Sixth Semester Examination – 2011

MASS TRANSFER - II

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.

1. Answer the following questions : 2×10

   (a) What do you mean by constant drying condition ?

   (b) What is freeze drying and what type of materials are dried by it ?

   (c) What is plait point and tie line in leaching ?

   (d) Define bound moisture and unbound moisture.

   (e) What is the value of y_s, Y_s, and N_s for pure solvent, where y_s, Y_s are the weight factions of solute in extracting solvent and weight faction of solute on solvent free basis respectively and N_s is the weight faction of solvent on solvent free basis ?

   (f) The extraction operation for the system of partial miscible solvents, should be done bellow critical solution temperature. Why ?

   (g) What do you mean by constant underflow condition in leaching ?

   (h) Define decoction and elution in leaching.

   (i) What are the effects of pressure and temperature on adsorption ?

   (j) What type of drying equipments are used for drying paper, clothes, slurry, and solutions ?

P.T.O.

2. If 1000 kg/h of nicotine (C) - water (A) solution containing 1% nicotine is to be counter currently extracted with kerosene at 20°C to reduce the nicotine to 0.1%, determine : 10

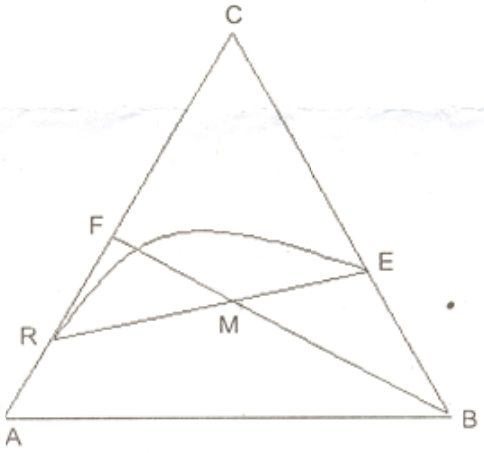
(a) The minimum kerosene rate

(b) The number of theoretical stages required if 1150 kg of kerosene is used per hour.)

$(x') = \frac{\text{kg nicotine}}{\text{kg water}}$	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0204
$(y') = \frac{\text{kg nicotine}}{\text{kg kerosine}}$	0	0.000807	0.001961	0.00456	0.00686	0.00913	0.0187

3. (a) Explain about the selectivity, distribution coefficient, insolubility of solvent, recoverability, and chemical reactivity considered during the choice of solvent in solvent extraction. 5

(b) In the triangular diagram represented below for a batch separation process, a stream F is mixed with a solvent B to produce products R and E. Substance A is the carrier liquid and C is the solute to be extracted. The amounts of B and E are 1 kg and 1.20 kg respectively. The length FM is 3.1 and length FB is 8.5 units on the figure. Calculate R/E. 5



4. Seeds, containing 20% by weight of oil are extracted in a counter current plant and 90% of the oil is recovered in a solution containing 50% by weight of oil. If the seeds are extracted with fresh solvent and 1 kg of solution is removed in the underflow in association with every 2 kg insoluble matter, how many stages are required for overall efficiency of 50% ? 10

5. The equilibrium adsorption of acetone vapor on activated carbon at 30°C is given by :

$\frac{\text{gm adsorbed}}{\text{gm carbon}}$ (X)	0	0.1	0.2	0.3	0.35
Partial pressure of acetone, mm Hg	0	2.0	12.0	42.0	92.0

A litre flask contains air and acetone vapor at 1 atm and 30°C with partial pressure of acetone 100 mm Hg. 2 gm of fresh activated carbon is introduced into the flask and it is sealed. Compute the final vapor concentration at 30°C and the pressure inside the flask. Neglect the adsorption of air. 10

6. (a) Derive the expression for the calculation of total time of drying for a weight solid having free moisture content in the region comprising of constant rate period and falling rate period. 6

(b) Under constant drying condition, time taken for drying a wet solid from 30% to 4% is 4 hour (dry basis). How long it takes to dry to 7% ? Given critical moisture content is 10% and equilibrium moisture content is 2%. 4

7. A pigment material which has been removed wet from a filter press is to be dried by extruding it into small cylinders and subjecting them to through circulation drying. The extrusions are 6 mm in diameter, 50 mm long, and are to be placed on screens to a depth of 65 mm. the surface of the particles is estimated to be 295 m^2/m^3 of bed and the apparent density 1040 kg dry solid / m^3. Air at a mass velocity 0.95 kg dry air/m^2. s will flow though the bed, entering at 120°C, humidity 0.05 kg water / kg dry air. Estimate the constant rate of drying to be expected.

Note : For long cylinder it is best to take the equivalent diameter as the actual cylinder diameter.

$\mu_{air} = 1.9 \times 10^{-5} \frac{kg}{m.s}$, $j_D = \left(\frac{2.06}{\varepsilon}\right) Re^{-0.575}$, Sc = 0.6, t_{as} = 47°C,

Humidity Y_{as} = 0.081 kg water / kg dry air. 10

8. (a) What are the factors affecting the constant rate period for a cross circulation batch drying process ? 3.5

(b) What are the characteristics of a good adsorbent ? 3.5

(c) What is the effect of temperature and pressure on ternary system having one binodal curve ? 3