M. TECH. –II (CHEMICAL ENGINEERING) (CBCS – 2015 COURSE) : WINTER - 2017

SUBJECT: ADVANCED MASS TRANSFER

Day: Thursday
Date: 30/11/2017

Time: 11.00 AM TO 02.00 PM
Max. Marks: 60

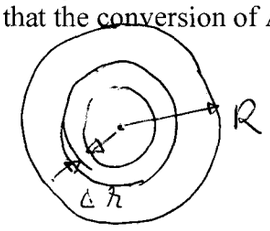
W-2017-2828

N.B:

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Answer to both the sections should be written in **SEPARATE** answer book.
4) Assume suitable data if necessary.

SECTION-I

Q.1 Consider a spherical catalyst as shown in figure in which species A diffuses into the catalyst and undergoes an irreversible reaction, $A \xrightarrow{k_1} B$. Assume the steady state diffusion accompanied by homogeneous chemical reaction and that the conversion of A to B can be expressed by first order kinetics. **(10)**



Derive an expression for concentration profile and prove that

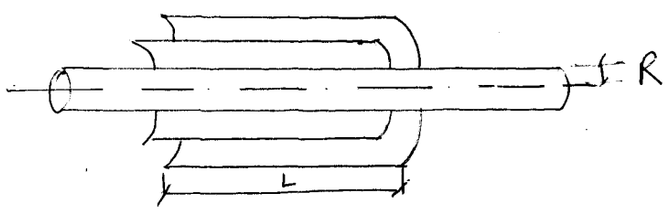
$$\frac{C_A}{C_{A_S}} = \frac{R \sinh(3\phi r / R)}{r \sinh(3\phi)}$$

OR

Q.1 Gas A diffuses through a stagnant gas film to the surface a nonporous cylindrical catalyst as shown in figure, where it undergoes the reaction. **(10)**

$2A \xrightarrow{k_1} B$

Gas B then diffuses from catalyst surface and is swept away. Neglecting diffusion and reaction on the ends of the particle, derive an expression for molar flux of A if the reaction is very fast.



Q.2 Discuss in detail the mechanism of ionic separations. Also state its commercial Applications. **(10)**

OR

Q.2 Discuss in detail about dielectrophoresis and electro dialysis. **(10)**

Q.3 Discuss in detail about simulated moving bed systems in adsorption with neat sketch. **(10)**

OR

Q.3 Write a note on: **(10)**
i) chromatography operation
ii) immuno- chromatography operation

P.T.O.

SECTION-II

Q.4 Discuss about the recent advances in distillation column design. Explain the operation of Petlyuk column and state its advantages over conventional distillation column. **(10)**

OR

Q.4 Define heavy and light key components in multi-component distillation. **(10)**
A liquid has the following composition: propane 1.36%, i-butane 14.33%, n-butane 16.37%, i-pentane 17.88% and n-butane 34.40%. This liquid is to be separated into a distillate product which contains 95% of the n-butane originally contained in the feed and a bottom product that contains 98% of the i-pentane contained in the feed. Using the results in the table below, estimate the feed tray location.

Component	Z_F	d	b
C_3	1.36	1.36	$5.39 X10^{-6}$
iC_4	14.33	14.27	0.059
nC_4	16.37	15.55	0.82
iC_5	15.66	0.31	15.35
nC_5	17.88	0.046	17.83
C_6	34.40	$1.68X10^{-5}$	34.40

Q.5 Describe in brief gas permeation membrane processes. Explain the working of spiral wound membrane module. **(10)**

OR

Q.5 Classify membrane separations processes. Discuss in detail cross flow model and countercurrent flow model for gas permeation by membranes. **(10)**

Q.6 What is zone melting? Discuss about the separations based on thermal diffusion. **(10)**

OR

Q.6 Write a note on: **(10)**

a) Reactive extraction

b) Supercritical fluid extraction

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