Sixth Semester B. Tech. Biotechnology (C.B.S) Examination

BIOCHEMICAL REACTION ENGINEERING – II

BTBIT 603 T

Time : Three Hours] [Max. Marks : 80

N. B. : (1) All questions carry equal marks.
(2) Answer any **Five** questions.
(3) Assume suitable data wherever necessary.
(4) Diagrams and Chemical equations should be given wherever necessary.
(5) Illustrate your answers wherever necessary with the help of neat sketches.

1. (a) Dilute A diffuses through a stagnant liquid film on to a plane surface of solid B. On this plane surface, A and B react to yield liquid product R which then diffuses back through the film into the main liquid stream. Develope the overall rate expression for the L/s reaction.

$A_{(l)} + B_{(S)} \longrightarrow A_{(l)}$ ..... first order w.r.t. A. 8

(b) Gaseous reactant A difluses through a gas film to the surface of solid B where it react with B according to reversible first order rate,

$-\gamma_A'' = K'' (CAs - CAe)$, mol/m^2, sec.

where CAe is the concentration of A in equilibrium with the solid surface. Derive an expression for the rate of reaction of A that accounts for both the mass transfer and reaction steps. 8

2. (a) What are the characteristics of catalysed reaction. Explain the Mechanism of Solid catalysed reactions. 8

(b) The following kinetic data on the solid catalysed reaction A $\longrightarrow$ 3 R are obtained, in a basket typed of mixed flow reactor 960 cm^3 in volume and containig 1 gm of catalyst, by conducting runs at 8 atm and 700^0C using pure A as feed.

Kinetic data : The Partial presence of A in the exit stream at various feed rates :—

Feed rate,lit/hr	100	22	4	1	0.60
P_A out/P_A in	0.8	0.5	0.2	0.1	0.05

Find the rate equation for this reaction. 8

3. (a) We plan to remove 90% of the reactant present in a gas stream by absorption in water.

Find the volume of tower required for counter current operation.

Data :

For gas stream :

Fg = 90000 mol/hr at $\pi = 10^5$ Pa.

P_A in = 1000 Pa, P_A out = 100 Pa.

For the Packed bed :—

Fe = 900000 mol/hr,

KAg a = 0.36 mol/(hr.m^3. Pa)

KAL a = 72 hr^{-1}

Molar density of liquid under all condition is

CT = 55556 mol/m^3

and HA = 18 (Pa.m^3)/mol,

K = 0 m^3/(mol.hr) 10

(b) Explain shrinking–core model for spherical particle of unchnaging size in detail. 6

4. (a) A sucrose is hydrolysed at ambient temp. by the enzyme sucrase as follows :

$$\text{Sucrose} \xrightarrow{\text{sucrase}} \text{Product}$$

Starting with sucrose concentration CA_0 = 1 mol/m^3 and a sucrase (enzyme) concentration

CE_0 = 0.01 mol/m^3 the following kinetics data are obtained in a batch reactor.

t, hr	2	6	10
C_A, mol/m^3	0.68	0.16	0.006

Find a rate equation to represent the kinetics of this hidrolysis reaction. 8

(b) Derive the equation for Batch, Plug flow and mixed flow fermentor. 8

5. Explain Inhibition of Enzyme reaction by a foreign substance.
Derive the kinetics equation for competitive Inhibition and Non–competitive Inhibition. Describe the method to find Inhibition Type from Experiment. 16

6. (a) What do you mean by deactivating catalysis. Explain its mechanism. 8

(b) Derive an expresion for conversion (X_A) as a function of time for irrevesible first order reaction A $\longrightarrow$ R, which is carried out isothermally in a batch reactor on a catalyst that is decaying as per following decay law :

$$\frac{-da}{dt} = k_d.a$$

8

7. (a) Write a short note on various immobilization technique of enzyme. 8

(b) Differentiate between substrate–Limiting Microbial fermetation and Product–Limiting Microbial Fremantion. 8

8. Write short note on :—

(a) Macro using RTD analysis.

(b) Pore diffusion resistance.

(c) Catalyst regeneration.

(d) Protein Ligand Interaction–Hill equation. 16