

NTK/KW/15 – 7956

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

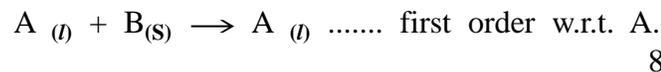
**BIOCHEMICAL REACTION ENGINEERING – II
BTBIT 603 T**

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. Develop the overall rate expression for the L/s reaction.



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

$$-r_A'' = K'' (C_{As} - C_{Ae}), \text{ mol/m}^2, \text{ sec.}$$

where C_{Ae} 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

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Contd.

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 $A \rightarrow 3R$ 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°C 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
$P_A \text{ out}/P_A \text{ in}$	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 :

$$F_g = 90000 \text{ mol/hr at } \pi = 10^5 \text{ Pa.}$$

$$P_A \text{ in} = 1000 \text{ Pa, } P_A \text{ out} = 100 \text{ Pa.}$$

For the Packed bed :—

$$F_e = 900000 \text{ mol/hr,}$$

$$K_A a = 0.36 \text{ mol}/(\text{hr.m}^3 \cdot \text{Pa})$$

$$K_{AL} a = 72 \text{ hr}^{-1}$$

Molar density of liquid under all condition is

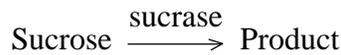
$$CT = 55556 \text{ mol/m}^3$$

$$\text{and } HA = 18 \text{ (Pa.m}^3\text{)/mol,}$$

$$K = 0 \text{ m}^3\text{/(mol.hr)} \quad 10$$

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

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



Starting with sucrose concentration $CA_0 = 1 \text{ mol/m}^3$ and a sucrase (enzyme) concentration

$CE_0 = 0.01 \text{ mol/m}^3$ the following kinetics data are obtained in a batch reactor.

t, hr	2	6	10
$C_A, \text{ mol/m}^3$	0.68	0.16	0.006

Find a rate equation to represent the kinetics of this hydrolysis 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 expression for conversion (X_A) as a function of time for irreversible first order reaction $A \rightarrow R$, which is carried out isothermally in a batch reactor on a catalyst that is decaying as per following decay law :

$$\frac{-da}{dt} = k_d \cdot a \quad 8$$

7. (a) Write a short note on various immobilization technique of enzyme. 8
- (b) Differentiate between substrate-Limiting Microbial fermentation and Product-Limiting Microbial Fermentation. 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