04/06/15

Bioreactor Analysis & Technology
BT/VI/CBGS/BAT

QP Code : 3432

(3 Hours) **[Total Marks : 80**

Note:

1. Question No. 1 is compulsory.
2. Attempt any three questions out of remaining five questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

Q. 1 Answer the following (Any four) 20

a. What are non-ideal flow reactors? Explain the concept of RTD for non- ideal flow reactors.

b. What is the criteria used for selection of a bioreactor?

c. Derive the performance equation for CSTR.

d. Explain the thermal stability of CSTR.

e. What are the methods used to analyze the kinetic data for batch reactor? Explain any one in detail.

Q.2a. Show that in case of CSTRs in parallel, the conversion achieved in any one of the reactors is same as that would be achieved if the reactants were fed in one stream to one large reactor of volume V. 10

b. What are the methods of modeling of non-ideal flow behavior? Explain any one in detail. 10

Q.3a. A first order reaction A $\xrightarrow{ki}$ B was carried out in a tubular reactor (length 6.4m and diameter 0.1m), for which $k_1 = 0.25\ min^{-1}$, the results of tracer test are given below; 12

t (min)	0	2	4	6	8	10	12	14
C (mol/lit)	0	5	10	6	3	1.5	0.6	0

Find the conversion of A using dispersion model.

b. Compare batch and continuous reactors. 05

c. Differentiate between elementary and non-elementary reactions. 03

Q.4a. Explain substrate and product inhibition. 08

b. A specific enzyme acts as a catalyst in the fermentation of reactant A. At a given enzyme concentration in the aqueous feed stream of 25lit/min, determine the size of a PFR needed to achieve 95% conversion of reactant A (C_{AO} = 2 mol/lit). The kinetics of the fermentation reaction is given as follows; 12

$$A \xrightarrow{Enzyme} R, \quad -r_A = \frac{0.10\ C_A}{1+0.5C_A} \quad mol/lit.min$$

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Q.5a. Derive the steady state mass balance for heterogeneous reaction. 08

b. A batch reactor is operated for converting A ⟶ R. This is a liquid phase reaction with stochiometry A ⟶ R. How long must we react each batch for concentration to drop from C_{AO}= 1.3 mol/lit to C_{Af} = 0.3 mol/lit. 12

Data:

C_A (mol/lit)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$ (mol/lit. min)	0.1	0.3	0.5	0.6	0.5	0.25	0.1	0.06	0.05	0.045	0.042

For the same reaction, determine the size of PFR that would be needed for 80% conversion of a feed stream of 1000mol A/hr at C_{AO}= 1.5 mol/lit.

Q.6 Write a short note on any four. 20

a. Tank in series model
b. PFR in series
c. Biomass production and dilution rate
d. Kinetics of enzyme deactivation
e. Series and parallel reactions

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