

1 - E - V sem - Biotech.

Bioreactor Analysis & Technology

(15)

TE/V/CBGS/BT/B.A&T

Q.P. Code : 31237

2106/2016

(3 HOURS)

(MAX. 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.

Q.1 Answer the following

- a. Explain zeroth order reaction, first order reaction and reaction rate constant.
- b. Differentiate between CSTR and PFR.
- c. What are homogeneous and heterogeneous reactions?
- d. What are the types of bioreactors?
- e. What are non-ideal reactors?

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Q.2 a. A reaction $A + 2B \longrightarrow C$ takes place in a two stage CSTR one of volume 100 m^3 and the other 50 m^3 . The volumetric feed rate is 10 lit/min . $C_A = C_B = 1.5 \text{ mol/lit}$ and the overall rate constant is $0.01 \text{ lit/mol. Min}$. Calculate the overall conversion.

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b. Explain on what factors the residence time distribution depends on non-ideal reactors?

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Q.3 a. Derive the performance equation for steady state batch reactor.

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b. The gas phase reaction $2A + 4B \longrightarrow 2C$, which is first order in B is carried out isothermally in a plug flow reactor. The entering volumetric flow is $2.5 \text{ dm}^3/\text{min}$, and the feed is equimolar in A and B. The feed enters the reactor at 727°C and 10 atm . The rate constant at this temperature is $4 \text{ dm}^3/\text{mol. min}$.

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i) What is the volumetric flow rate when conversion is 25%?

ii) What is the rate of the reaction at the entrance of the reactor?

iii) What is the rate when conversion of A is 40%?

iv) What is the concentration of A at the entrance of the reactor?

v) What is the concentration of A at 40% conversion?

Q.4 a. Explain the effect of substrate and product inhibition on cell growth.

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b. A particular fermentation is to be carried out in a chemostat. Before carrying out, the actual fermentation, it was decided to evaluate the flow characteristics of the chemostat by introducing a tracer in the form of pulse input. The time versus concentration of the tracer data are presented below. Find the average residence time and exit edge distribution E.

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t (min)	0	10	20	30	40	50	60	70
Tracer conc. (g/l)	0	2	6	7	5	3	1	0

Q.5 a. Explain the modeling of non-ideal reactors.

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[P.T.O]

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(2)

- b. The enzyme ATPase catalyzes the reaction $\text{ATP} + \text{ADP} \longrightarrow \text{P}_i$. In the process the enzyme gets deactivated. The deactivation rate constant was determined at different temperatures. The results are; 10

Temp. ($^{\circ}\text{C}$)	25	30	35
k_d (min^{-1})	0.0825	0.0907	0.1

- Q.6 Write a note on (Any four) 20
- Plug flow reactor
 - Thermal behavior of CSTR
 - Fluidized bed reactor
 - Kinetic model for cell growth
 - RTD studies
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