T.E - V Sem - Bioteech.

2/06/2016

Bioreactor Analysis & Technology

(15)

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

Q.P. Code : 31237

(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. 20
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?

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. $C_A = C_B = 1.5$ mol/lit and the overall rate constant is 0.01 lit/ mol. Min. Calculate the overall conversion. 10

b. Explain on what factors the residence time distribution depends on non-ideal reactors? 10

Q.3 a. Derive the performance equation for steady state batch reactor. 5

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 dm^3/ 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 dm^3/ mol. min. 15

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. 8

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. 12

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. 10

[P.T.O]

b. The enzyme ATPase catalyzes the reaction ATP + ADP ⟶ P_i. In the process the enzyme gets deactivated. The deactivation rate constant was determined at different temperatures. The results are; 10

Temp. (^{O}C)	25	30	35
k_d (min^{-1})	0.0825	0.0907	0.1

Q.6 Write a note on (Any four) 20

a. Plug flow reactor

b. Thermal behavior of CSTR

c. Fluidized bed reactor

d. Kinetic model for cell growth

e. RTD studies
