Exam.Code:0908
Sub. Code: 6303

2053

B.E. (Biotechnology) Fourth Semester

BIO-413: Chemical Reaction Engineering

Time allowed: 3 Hours

Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.*

x-x-x

1. Attempt the following:-

a) Derive expressions for the overall conversions for a reaction of known order.

b) Differentiate elementary and non-elementary reactions.

c) What do you understand if the space time of a flow reactor is reduced?

d) Express the most essential requisite for running a continuous reactor.

e) Assuming any reactor operation, differentiate between competitive and non-competitive inhibition for an enzyme reaction.

f) A simple autocatalytic reaction is represented by $A+B \rightarrow B+B$. starting with a small concentration of B, show in a plot how the rate will rise as B is formed.

g) What is the relation between initial concentration (Co) and final concentration (C4) for a system of 4 equal sized mixed reactors in series? Assume reaction is of first order and t is the residence time.

h) Define temperature dependency as per Arrhenius law.

i) Deduce the expression for conversion for a variable density system.

j) Enlist the kinetic models for the evaluation of non-elementary reactions.

(1x10)

Section – A

2. Distinguish between the methods available for establishing the kinetics of chemical reactions from the data obtained in a batch or continuous reactor. Give a brief account on determination of overall order of reaction from half-life method. (10)

3. A) Compare the performances and merits of the plug flow and the stirred tank reactors behaving ideally.

B) A gaseous feed of pure A (2 mol/liter, 100 mol/min.) decomposes to give a variety of products in a plug flow reactor. The kinetics of conversion is represented as by **A → 2.5 Products**, $-r_A = (10\ min^{-1}).C_A$. Find the expected conversion in 22-liter reactor. (4,6)

P.T.O.

4. An elementary reaction A → R → S, takes place in a mixed flow reactor. Find the condition for maximum concentration of R. What is its value? (Assume no R and S initially; Also $k_1 = k_2$). (10)

Section – B

5. What is understood by 'optimum temperature progression'? Illustrate with an example of reversible exothermic reaction using a given feed material. (10)

6. a) An aqueous reactant stream (4 mol A/ liter) passes through a mixed flow reactor followed by a plug flow reactor. Find the concentration at the exit of the plug flow reactor if in the mixed flow reactor C_A = 1 mol/liter. The reaction is second order with respect to A, and the volume of the plug flow unit is three times that of mixed flow unit.

   b) Illustrate which type of reactor would you choose for series reaction scheme A→ R→ S for different combinations of k_1 and k_2. (6,4)

7. A) Discuss in details substrate limited cell-growth and the toxin limited cell-growth.
   B) Discuss the Monod's growth model for describing the kinetics of substrate utilization. (5,5)

x-x-x