SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

ROLL No: | | | | | | | | | | | | | **Total number of pages:[3]**

B.Tech. || CHE || 4th Sem
Chemical Reaction Engineering-I (RP)
Subject Code:BTCH-405
Paper ID: M|18
(2011-2014 batch)

Time allowed: 3 Hrs **Max Marks: 60**

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**
- **Additional instructions, if any**

PART A (10x 2marks)

Q. 1. Short-Answer Questions:

(a) Define the term 'specific reaction rate' or 'rate of reaction'.
(b) What are single and multiple reactions?
(c) A reaction has the stoichiometric equation $2A + B \rightarrow 3R$. What is the order of reaction?
(d) What are the advantages and disadvantages of batch reactor?
(e) Define space velocity and what are its units?
(f) Write the empirical rate equation of n^{th} order.
(g) For an irreversible gas phase reaction $2A \rightarrow 3R$, determine the value of ε_A if the feed is a mixture of 50% A and 50% inert.
(h) Differentiate micro fluid from macro fluid.
(i) When will the recycle reactor behave like a CSTR?
(j) What are autocatalytic Reactions?

PART B (5×8marks)

Q2 Derive the rate equation for the irreversible bimolecular-type first-order batch reaction $A + B \rightarrow$ products, for constant volume and variable volume. CO1

Or

(a) Differentiate constant volume and variable volume methods of analysis of reactors.
(b) The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500°C?

Q3 (a) Differentiate between differential and integral method of analysis of batch rector data. CO2

(b) Liquid A decomposes by second-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion?

Or

(a) An ampoule of radioactive Kr-89 (half life = 76 minutes) is set aside for a day. What does this do to the activity of the ampoule? Note that radioactive decay is a first-order process..

(a) Differentiate between CSTR and PFR.

(4+4)

Q4 Derive the performance equations for steady state mixed flow reactor and plug flow reactor. CO3

Or

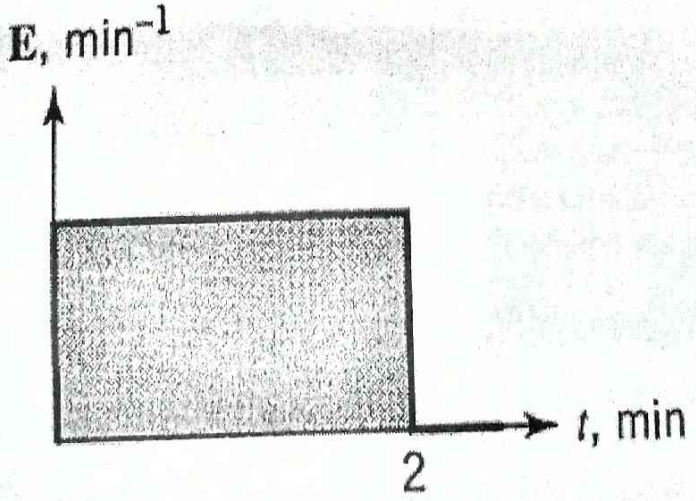
An aqueous reactant stream (4 mol A/liter) passes through a mixed flow reactor followed by a plug flow reactor. Find the concentration at the exit of the plug flow reactor if in the mixed flow reactor $C_A = 1$ mol/liter. The reaction is second-order with respect to A, and the volume of the plug flow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

Q. 5. (a) What is Residence Time Distribution? How it can be found experimentally? CO4

(ii) A liquid macrofluid reacts according to A→ R as it flows through a vessel. Find the conversion of A for the flow pattern shown below and kinetics as shown.

$$C_{A0} = 1 \text{ mol/liter}$$
$$-r_A = kC_A^{0.5}$$

$$k = 2\frac{mol^{0.5}}{ltr^{0.5}.min}$$



Or

The concentration readings in Table below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor.
Calculate the mean residence time of fluid in the vessel t, and tabulate and plot the exit age distribution **E.**

Time t, min	Tracer Output Concentration, C_{pulse} gm/ltr fluid
0	0
5	3
10	5
15	5
20	4
25	2
30	1
35	0

Q. 6 (a) What are the operating conditions for an exothermic reversible reaction-taking place in a plug-flow reactor? Give the uses of PFR. CO

(b) Write short note on Temperature progression.

Or

Between 0°C and 100°C determine the equilibrium conversion for the elementary aqueous reaction

$A \leftrightarrow R$, ΔG^{o}_{298}= -14130 J/mol , ΔH^{o}_{298}= -75300 J/mol

$C_{pA} = C_{pR}$ = Constant

(a) Present the results in the form of a plot of temperature versus conversion.
(b) What restrictions should be placed on the reactor operating isothermally if we are to obtain a conversion of 75% or higher?

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