22512

11920

3 Hours / 70 Marks

Seat No. | | | | | | | | |

Instructions : (1) All Questions are *compulsory*.

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

(5) Use of Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. Attempt any FIVE : **10**

(a) Define the term activation energy.

(b) Define fractional change in volume (E_A).

(c) Give the relation between C_A and X_A for constant density and changing density reaction systems.

(d) Draw a neat sketch of plug flow reactors connected in series-parallel combination.

(e) Give any two applications of fluidised bed reactor and packed bed reactor each.

(f) Define autocatalytic reaction with example.

(g) List any four applications of batch reactor.

2. Attempt any THREE : 12

(a) Differentiate between molecularity and order of reaction. (any four points)

(b) Liquid 'A' decomposes by first order kinetics and in a batch reactor. 50% of A is converted in 5 minutes, how long will it take to reach 75% conversion ?

(c) Explain the terms – space time and space velocity with their units and mathematical expression.

(d) Compare MFR & PFR (any 8 points).

3. Attempt any THREE : 12

(a) Describe important properties of catalyst.

(b) The half-life for the conversion of ammonium cynate into urea at 303 K at initial concentrations of ammonium cynate of 0.1 mol/l and 0.2 mol/l are 1152 min and 568 min, respectively. Find the order of this reaction.

(c) Derive an integrated rate expression for irreversible uni-molecular type first order reaction in terms of concentration and conversion.

(d) Explain the procedure to find the conversion when MFR's of different sizes are connected in series.

4. Attempt any THREE : 12

(a) In an isothermal batch reactor the conversion of a liquid reactant 'A' is 70% in 13 min. Find the space time and space velocity necessary to effect this conversion in a PFR and in a MFR. Consider first order kinetics.

(b) Derive an integrated rate expression for zero order reaction for a variable volume reaction system. Also, show graphical representation.

(c) Explain the differential method of analysis of kinetic data with stepwise procedure.

(d) Derive an expression which represents conversion as a function of number of equal size CSTR's in series.

(e) Explain the method of feeding when plug flow reactors are connected in parallel.

5. Attempt any TWO : 12

(a) Explain the temperature dependency of rate constant form Arrhenius law.

(b) Explain the terms – promoters, accelerators and inhibitors with suitable example.

(c) The kinetic data of a certain decomposition reaction is shown below :

Time, min	**Concentration, mol/*l***
0	0.10
10	0.0714
20	0.0556
40	0.0385
100	0.02
125	0.0167

Find the order and rate constant for this reaction.

6. Attempt any TWO : 12

(a) Derive the performance equation for ideal batch reactor for constant volume and variable volume reaction system.

(b) A homogeneous gas phase reaction $A \rightarrow 3R$, proceeds with $-r_A = 10^{-1} C_A$, [mol/(l.s)] at 200 °C. Find the space time required to achieve 80% conversion of a 50 mole% 'A' and 50 mole % inerts feed to a PFR operating at 200 °C and 5 atm pressure. The initial concentration of 'A' is 0.0625 mol/l.

(c) A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = K C_A^2$ takes place with 50% conversion in MFR. Find the conversion if the reactor is replaced by PFR of equal size. All else remaining unchanged.
