22512

12425

3 Hours / 70 Marks Seat No. | | | | | | | | |

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

(2) Answer each next main Question on a new page.

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

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

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

Marks

1. Attempt any FIVE of the following : **10**

(a) Define autocatalytic reaction.

(b) Write the formula to calculate unit of rate constant for n^{th} order reaction.

(c) Give examples of reactors used in industry (any four).

(d) Draw the graphical representation which shows size comparison of MFR and PFR at conversion X_A.

(e) Define the term promotor and accelerator used in case of catalytic reactions.

(f) Define space velocity and space time with unit.

(g) State two methods of determining kinetics of chemical reaction.

2. Attempt any THREE of the following : **12**

(a) State and explain the factors which affect the performance of chemical reaction.

(b) Derive the integrated form of rate expression for zero order reaction.

(c) Derive the performance equation for batch reactor.

(d) Explain the criteria for series-parallel arrangement of PFR.

3. Answer any THREE of the following : **12**

(a) List the different methods used for catalyst preparation and explain any one in detail.

(b) For the reaction under consideration the 60% conversion is obtained in 3 min and 80% conversion is obtained in 8 min. Determine the value of order of reaction and rate constant.

(c) The half life period for certain first order reaction is 2500 s. How long will it take for $¼^{th}$ of the reactant to be left behind ?

(d) In an isothermal batch reactor, the conversion of a liquid reactant A achieved in 30 min is 70%. Find space time to obtain same conversion in MFR.

4. Attempt any THREE of the following : **12**

(a) A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = kC_A^2$ takes place with 50% conversion in MFR. What will be space time required to obtain 80% conversion in same reactor ? All else conditions remains same. (Find τ_2/τ_1)

(b) For reaction represented as A → P the following data was obtained at 25 °C :

t(min)	0	10	20	30	40
$\mathbf{C_A\left(\frac{mol}{L}\right)}$	0.860	0.740	0.635	0.546	0.405

Find the order of reaction.

(c) Explain the graphical procedure to find the conversion obtained in case of unequal size MFR connected in series.

(d) A liquid phase reaction A + B → product has $-r_A = 500\ C_A C_B$, K = 500 *l*/mol · min is carried out in PFR of volume 0.1 L and volumetric flow rate 0.05 L/min, $C_{A_O} = C_{B_O}$ = 0.01 mol/L. Find the fractional conversion.

(e) Explain the half life method of determining kinetics of reaction.

5. Attempt any TWO of the following : **12**

(a) At 500 K, the rate of bimolecular reaction is 10 times than at 400 K. Find activation energy of this reaction using Arrhenius theory.

(b) Explain the stepwise mechanism of solid catalyzed reaction.

(c) In case of first order reaction, show that the time required for 50% conversion is half of the time required for 75% conversion.

6. Attempt any TWO of the following : **12**

(a) An isothermal batch reactor used for conversion of liquid phase reactant A. 75% conversion is obtained in 15 min.

Find the space time and space velocity to affect this conversion in PFR. Assume n = 1.

(b) Use graphical method to calculate the space time required to obtain 60% conversion in MFR. The molar flow in a reactor is 10 mol/s.

X_A	0	0.2	0.4	0.6	0.8
$-r_A \left(\frac{mol}{l.s.}\right)$	0.182	0.143	0.10	0.0667	0.0357

(c) How the best arrangement of different reactor connected in a series is determined ? Explain the procedure.
