24225

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) Preferably, write the answers in sequential orders.

Marks

1. Attempt any FIVE of the following : **5 × 2 = 10**

(a) Define the rate of reaction and rate constant.

(b) Define fractional conversion and fractional change in volume.

(c) Give the material balance equation for a reactor.

(d) Draw a neat sketch of two unequal size MFRs in series.

(e) List any four applications of fluidized bed reactor.

(f) Define autocatalytic reaction. Give one example.

(g) Define space time.

2. Attempt any THREE of the following : **3 × 4 = 12**

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

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

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

(d) Compare MFR and PFR. (four points)

3. Attempt any THREE of the following : **3 × 4 = 12**

(a) Describe important properties of catalyst.

(b) The half life period of a first order reaction is 240 sec. Calculate its rate constant in sec. and min.

(c) Derive the integrated form of rate expression for zero order reaction in terms of conversion.

(d) Draw a neat sketch of PFRs in series parallel arrangement.

4. Attempt any THREE of the following : **3 × 4 = 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 MFR. Consider first order kinetics.

(b) Derive intergrated rate expression for second order reaction in terms of conversion.

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

(d) Show that the total volume (V) of two plug flow reactor in series is identical to that of single plug flow reactor volume (V) for the same conversion.

(e) List any two advantages and disadvantages of batch reactor.

5. Attempt any TWO of the following : **2 × 6 = 12**

(a) Derive the temperature dependency of rate constant from transition state theory.

(b) Explain the terms-promotors, accelerators and inhibitors with suitable example.

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

Time (min)	0	10	20	40	100	125
Conc. (mol/lt)	0.10	0.0714	0.055	0.038	0.02	0.016

Find the order and rate constant for this reaction.

6. Attempt any TWO of the following : **2 × 6 = 12**

(a) Derive the performance or design equation for ideal batch reactor in terms of conversion.

(b) It is proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with the stoichiometry $A \longrightarrow R$. Find the time required to drop/fall the concentration of A from C_{AO} = 1.3 mol/*l* to C_{Af} = 0.3 mol/*l*. The rate Vs concentration data are as given below :

mol/l C_A	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$\text{mol}/l.\text{min}$ $-r_A$	0.1	0.3	0.5	0.6	0.5	0.25	0.1	0.06	0.05	0.045	0.042

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