22512

21222

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

15 minutes extra for each hour

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) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following : 10

(a) Define rate of reaction and rate constant.

(b) List the methods for analysing kinetic data.

(c) Give the advantage and disadvantage of batch reactor (two each).

(d) Draw symbolic diagram of PFR in (i) series and in (ii) parallel arrangement

(e) Define promoters in catalysis.

(f) Define order of reaction.

(g) Define space time and space velocity.

2. Attempt any THREE of the following : 12

(a) Differentiate between molecularity and order of reaction (4 points).

(b) Derive the integral rate expression for first order reaction (A $\rightarrow$ product) in term of concentration.

(c) List the factors to be considered while designing a reactor.

(d) Differentiate between MFR and PFR (four points).

3. Attempt any THREE of the following : 12

(a) Define catalyst and explain any three desired properties of catalyst.

(b) The half-life period of first order reaction is 240 seconds. Calculate its rate constant in seconds and minutes.

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

(d) Explain the procedure to determine the best system for achieving desired conversion for different size MFR in series.

4. Attempt any THREE of the following : 12

(a) In an isothermal batch reactor, the conversion of a liquid reactant A achieved in 13 minutes is 70%. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor and in a mixed flow reactor. Consider the first order kinetics.

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

(c) Differentiate between integral method and differential method of analysis of kinetic data (4 points).

(d) List the general rules to be followed for the best arrangement of a set of ideal reactor.

(e) Explain the method of feeding when PFR's are connected in parallel.

5. Attempt any TWO of the following : 12

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

(b) Explain any six methods for regeneration of catalyst.

(c) In studying the kinetic of decomposition reaction, the concentration of reactant were determined analytically at different times. The following results were obtained.

Time (min.)	0	10	20	40	100	125
Conc. (mol/lit)	0.10	0.0714	0.0556	0.0385	0.02	0.0167

Determine the order and rate constant for the reaction.

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

(a) Derive the performance equation of constant volume plug flow reactor. Give the graphical representation of design equation.

(b) It is proposed to operate a batch reactor for converting A into R. This is a liquid phase reaction with the stoichiometry A → R. Find the time required to drop/fall the concentration of A from $C_{AO} = 1.3$ mol/l to $C_{Af} = 0.30$ mol/l. The rate vs. concentration data are as given below :

$C_A \frac{mol}{l}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A \left(\frac{mol}{l\ min}\right)$	0.1	0.3	0.5	0.6	0.5	0.25	0.10	0.06	0.05	0.045	0.042

(c) A liquid phase reaction A → R, $-r_A = KC_A^2$ takes place with 60% conversion in a MFR. Find the conversion if the reactor is replaced by another MFR whose volume is 6 times large, all else remaining unchanged.