

22512

21222

3 Hours / 70 Marks

Seat No.

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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 ($A \rightarrow \text{product}$) 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 $A \rightarrow R$. Find the time required to drop/fall the concentration of A from $C_{AO} = 1.3 \text{ mol/l}$ to $C_{Af} = 0.30 \text{ mol/l}$. The rate vs. concentration data are as given below :

$C_A \frac{\text{mol}}{l}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A \left(\frac{\text{mol}}{l \text{ min}} \right)$	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 $A \rightarrow R$, $-r_A = KC_A^2$ 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.
