

22512

23124

3 Hours / 70 Marks

Seat No.

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

Marks

1. Attempt any FIVE of the following :

5 × 2 = 10

- (a) Define rate of reaction & rate constant.
- (b) Define half life. Give its mathematical expression.
- (c) Define Space time and Space velocity.
- (d) List the types of reactor used in chemical industries.
- (e) Define Catalyst and Catalyst regeneration.
- (f) Define Fractional conversion.
- (g) Give the relation between conversion and concentration for constant density system.



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

- (a) Differentiate between molecularity and order of reaction (four points).
- (b) The rate constant of zero order reaction is 0.2 (mol/l.h). What will be the initial concentration of the reactant if, after half an hour, concentration is 0.05 mol/lit ?
- (c) Define Space time and Space velocity. Give its unit.
- (d) Explain how feed should be admitted when PFRs are connected in parallel.

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

- (a) Explain the different methods for preparation of catalyst.
- (b) State the general procedure for analysis of the complete rate equation by differential method.
- (c) With the help of example explain parallel and series reaction.
- (d) State advantages & disadvantages of Batch reactor.

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

- (a) Derive the design equation for batch reactor.
- (b) Decomposition of a gas is second order when the initial concentration of gas is 5×10^{-4} mol/lit. It is 40% decomposed in 50 min. Calculate the value of rate constant.
- (c) Derive the integrated rate equation for zero order reaction with graphical representation.
- (d) Compare MFR and PFR (any four points).
- (e) Plug flow reactor are not put in series. Justify with example.

5. Attempt any TWO of the following :

 $2 \times 6 = 12$

- (a) Derive the temperature dependency of rate constant from Collision theory.
- (b) Define catalyst deactivation. State its types and explain any two.
- (c) Show that the decomposition of N_2O_5 at $67^\circ C$ is first order reaction.

Calculate the value of rate constant

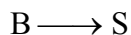
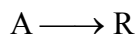
Data.

Time (min)	0	1	2	3	4
$C_{N_2O_5}$, mole/lit	0.16	0.113	0.08	0.056	0.040

6. Attempt any TWO of the following :

 $2 \times 6 = 12$

- (a) Concentration v/s time data for reaction is given below :



Time (hr)	Concentration of A mole/lit	Concentration of R mole/lit
0	0.100	0.00
2	0.050	0.0050

Time (hr)	Concentration of B mole/lit	Concentration of S mole/lit
0	0.100	0.00
2	0.075	0.025

Calculate :

- (i) Which reaction proceeds at faster rate
- (ii) What are the rates of formation of R & S.

P.T.O.

- (b) We are planning to operate a batch reactor to convert A into R. The stichometry is $A \longrightarrow R$ and rate of reaction is given in the table. How long must we react each batch for the concentration to drop from $C_{A0} = 1.3$ mol/lit to $C_A = 0.3$ mol/lit.

C_A mole/lit	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.3	2.0
$-r_A$ mole/l. min	0.1	0.3	0.5	0.6	0.5	0.25	0.1	0.06	0.05	0.045

- (c) The laboratory measurement of the rate V/s conversion for reactant A are given below. Compare the volume of mixed flow reactor (CSTR) and a plug flow reactor required to achieve 60% conversion. The feed conditions are the same in both the cases and molar flow rate of A entering the reactor is 10 mol/s.

X_A	0	0.20	0.40	0.60	0.80
$-r_A$ mole/l.s.	0.182	0.143	0.10	0.0667	0.0357
