22512

23124

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.

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

Marks

1. Attempt any FIVE of the following : **$5 \times 2 = 10$**

(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 : $3 \times 4 = 12$

(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 : $3 \times 4 = 12$

(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 : $3 \times 4 = 12$

(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 × 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 °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 × 6 = 12

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

$A \longrightarrow R$

$B \longrightarrow S$

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.

(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_{AO} = 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
–rA 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
–rA mole/*l*.s.	0.182	0.143	0.10	0.0667	0.0357