16172

3 Hours / 100 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.

Marks

1. (A) Attempt any THREE **12**

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

(b) Show that the decomposition of N_2O_5 at 67 °C is a first order reaction. Calculate the value of rate constant.

Data :-

Time (min)	0	2	3	4
(N2O5 (mol/*l*)	0.16	0.113	0.056	0.040

(c) Derive the relationship between $\Delta G°$ and kp.

(d) List types of reactors used in industry and write one application for each type.

(B) Attempt any ONE : **6**

(a) Derive temperature dependency of rate constant from Arrhenius law.

(b) State the general procedure for analysis of the complete rate equation by integral method.

2. Attempt any TWO : **16**

(a) Explain in brief chain reactions on doubling the concentration of reactant, the rate of reaction triples. Find the reaction order.

(b) The laboratory measurements of rate V/S conversion for reactant A are given below. Compare the volumes of a 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.

XA	0	0.20	0.4	0.60	0.80
–rA (mol/*l*.S)	0.182	0.143	0.10	0.0667	0.0357

(c) Explain in brief fluidised bed reactor with a neat sketch. Give merits and demerits of fluidised bed reactor. (two each)

3. Attempt any FOUR : **16**

(a) Find the equilibrium concentration of H_2,I_2 and HI if 5 millimoles of H_2 and 2 millimoles of I_2 are introduced in a one litre flask thermostated at 27 °C. K_C for the reaction at 27 °C is 16.34.

(b) Define half-life period. The half-life period for a certain first order reaction is 2500 sec. How long it will take for (1/4) of reactant to be left behind ?

(c) Derive the expression of entropy change in constant volume process of an ideal gas.

(d) Define rate of reaction and rate constant. Name the factors affecting the rate of reaction.

(e) Describe catalyst ingredients (Promotors, Inhibitors, Accelerators) with example.

4. (A) Attempt any THREE : **12**

(a) Derive the relation of concentration and conversion for constant volume batch system.

(b) Describe the method of catalyst preparations.

(c) Decomposition of a gas is second order. When the initial concentration of gas is 5×10^{-4} mol/l, it is 40% decomposed in 50 min. Calculate the value of rate constant.

(d) Give the feasibility criterion for a chemical reaction in terms of Gibb's free energy change.

(B) Attempt any ONE : **6**

(a) At 500 °k the rate of a bimolecular reaction is ten times the rate at 400 °k Find the activation energy for this reaction.

(i) From Arrhenius law

(ii) From collision theory

(b) Derive the Van't Hoff equation $\frac{d\ln k}{dT} = \frac{\Delta H^\circ}{RT^2}$

5. Attempt any TWO : **16**

(a) (i) Define zero order reaction. Derive its mathematical expression. State its important characteristics.

(ii) At certain temperature the half life periods and initial concentration for a reaction are $t_{½}$ = 420 sec, CAO = 0.405 mol/*l* and $t_{½}$ = 275 sec, CAO = 0.64 mol/*l*. Find the rate constant for a reaction.

(b) Derive a performance equation for plug flow reactor. State advantages and disadvantages of batch reactor.

P.T.O.

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

(ii) Consider a gaseous feed $C_A = 100$, $C_{BO} = 200$ to a steady flow reactor operated at constant T and P. The isothermal gas phase reaction taking place is $A + B \rightarrow R + S$ for $X_A = 0.8$, find C_A, C_B & X_B.

6. Attempt any FOUR : **16**

(a) Why plug flow reactors are not put in series ?

(b) Define entropy. Derive the expression of entropy change in isothermal expansion of an ideal gas.

(c) Define order of a chemical reaction and give classification of reaction based on it.

(d) Differentiate between integral method and differential method of analysing kinetic data. (Any 4 points)

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