17562

21415

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) Name the factors which are affecting the rate of reaction. (any four)

   b) Define internal energy and enthalpy. State their units.

   c) What is autocatalytic reaction ? Give its example.

   d) Differentiate between batch and continuous reactors.

   B) Attempt **any one :** **6**

   a) Derive a kinetic expression for second order reaction $2A \rightarrow$ products.

   b) The rate constants of a certain reaction are 1.6×10^{-3} and 1.625×10^{-2} $(S)^{-1}$ at 10°C and 30°C. Calculate the activation energy.

2. Attempt **any two** : **16**

   a) Give mathematical statement of Arheniou's law. Explain how energy of activation is obtained graphically.

   b) 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 and in a mixed flow reactor. Consider first order kinetics.

   c) List methods of catalyst preparation . Explain any two method in detail.

P.T.O.

MARKS

3. Attempt **any four** : **16**

a) Why knowledge of thermodynamics is essential to understand chemical reaction engineering ?

b) Give the relation between C_A and C_{AO} for constant volume system and variable volume system.

c) During the preparation of carbon monoxide by the reaction.

$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ at 1175 k and 1.02 atm pressure, the partial pressure of CO_2, H_2 and CO are 0.218, 0.258 and 0.272 atm respectively. Calculate K_p for the reaction.

d) Differentiate between molecularity and order of reaction (any four points).

e) Name the three catalyst deactivation categories. Describe any one.

4. A) Attempt **any three** : **12**

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

Data :

Time, min.	0	1	2	3	4
$C_{N2}O_5$, mol/l	0.16	0.113	0.08	0.056	0.040

b) Draw the diagrams of :

i) Packed bed reactor

ii) Multibed reactor

iii) Multi-tube fixed bed reactor

iv) Fluidised bed reactor.

MARKS

c) Define rate of reaction and rate constant. Give the units of rate constant for zero order and first order reaction.

d) How the feasibility of chemical reaction is determined from Gibbs free energy change ?

B) Attempt **any one** : **6**

a) Define activation energy. Draw the diagram showing the activation energy for exothermic and endothermic reaction. What is the role of activation energy in a chemical reaction ?

b) Explain relationship between standard Gibb's free energy and equilibrium constant.

5. Attempt **any two** : **16**

a) Derive the integrated form of rate expression for constant volume first order reversible reaction A $\rightleftharpoons$ B in terms of concentration and conversion. Give the graphical representation also.

b) Derive the design equation for batch reactor.

c) Compare the performance of mixed flow reactor and plug flow reactor. (Any 4 points)

6. Attempt **any four** : **16**

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

b) Define the following terms :

i) Chemical potential

ii) Fugacity

iii) Gibbs free energy

iv) Entropy.

MARKS

c) Differentiate between elementary and non-elementary reactions (any four points).

d) 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.

e) Define the term space time and space velocity with their units and mathematical expression.