17562

11920

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.

(5) Use of Non-programmable Electronic Pocket Calculator is permissible.

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

Marks

1. a) **Attempt any THREE of the following:** **12**

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

(ii) Explain the terms enthalpy and Gibb's free energy with their mathematical equation.

(iii) Define half-life of a reaction. If the half-line period of a first order reaction is 240 seconds, calculate its rate constant.

(iv) Draw a neat sketch of fluidized bed reactor with catalyst regenerator.

Marks

b) **Attempt any ONE of the following:** **6**

(i) List the methods of analysis of kinetic data. Explain the stepwise procedure of differential method of analysis of data.

(ii) Define the term activation energy. 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 and frequency factor.

2. Attempt any TWO of the following: **16**

a) Derive temperature dependency of rate constant from Transition state theory.

b) Derive the performance equation for steady-state mixed flow reactor for a constant volume system in which 1st order reaction is taking place. Also show graphical representation.

c) Define auto-catalysis. Explain the terms promoters, inhibitors and accelerators.

3. Attempt any FOUR of the following: **16**

a) Derive the relationship between equilibrium conversion and thermodynamic equilibrium constant for first order reversible reaction $A \rightleftharpoons R$.

b) The half life for the conversion of ammonium cynate into urea at 303 K at initial concentrations of ammonium cynate of $0.1\,mol/l$ and $0.2\,mol/l$ are 1152 min and 568 min, respectively. What is the order of reaction?

c) Calculate the entropy change when 2 moles of ice are heated from –10°C to 10°C.

Data:- $C_{p(ice)} = 9.0145\,{}^{cal}/_{(mol.k)}$, $C_{p(water)} = 18.0\,{}^{cal}/_{(mol.k)}$, molar enthalpy of fusion $= 1437.1\,{}^{cal}/_{mol}$.
(Assume heat capacities to be constant in this temperature range.)

d) State the factors affecting rate of a chemical reaction. (any four points).

e) Differentiate between fixed-bed and fluidized-bed reactor. (any four points).

Marks

4. a) **Attempt any <u>THREE</u> of the following:** **12**

(i) At 25°C the rate constant for the hydrolysis of ethyl acetate by NaOH is $6.5(^{l}/_{\text{mol}}).\text{min}^{-1}$ starting with concentration of base and ester of $0.03\ ^{\text{mol}}/_{l}$ of each. What proportion of ester will be hydrolysed in 10 min?

(ii) Write any four desired properties of a catalyst and define any two.

(iii) Show graphical representation of integrated rate equation for 2nd order reaction $2A \rightarrow$ products in terms of concentration and conversion.

(iv) Explain the feasibility criteria of a chemical reaction from Gibbs free energy change.

b) **Attempt any <u>ONE</u> of the following:** **6**

(i) The activation energy of a chemical reaction is 17982 $^{Cal}/_{mol}$ in the absence of a catalyst, and 11980 $^{Cal}/_{mol}$ with a catalyst. By how many times will the rate of reaction will grow in the presence of a catalyst, if a reaction proceeds at 25°C?

(ii) Derive the relation between Kp, Kc and Ky.

5. **Attempt any <u>TWO</u> of the following:** **16**

a) Derive an integrated rate expression for constant volume irreversible unimolecular type first order reaction in terms of concentration and conversion. Also show graphical representation.

b) The laboratory measurements of rate Vs conversion for reactant 'A' are given below. Compare the volumes of a mixed flow reactor 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	0.2	0.4	0.6	0.8
$(-\gamma A, \text{mol}/(l.s)$	0.182	0.143	0.1	0.0667	0.0357

c) Derive the design equation for ideal batch reactor. Also show the graphical representation.

Marks

6. Attempt any FOUR of the following: **16**

a) Explain the method of feeding when PER's are connected in parallel.

b) Derive an expression for entropy change of an ideal gas.

c) Define chain reaction and non chain reaction.

d) Derive an integrated rate expression for zero order reaction in terms of concentration and conversion.

e) Write advantages and disadvantages of batch reactor. (two each).
