Scheme - I

Sample Question Paper

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Fifth**
Course Title : **Chemical Reaction Engineering**
Marks : **70** **Time: 3 Hrs.**

22512

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) Preferably, write the answers in sequential order.

Q.1) Attempt any FIVE of the following. **10 Marks**

a. Define rate of reaction. Give the rate of reaction in terms of concentration of reactants.

b. Define C_A.

c. Give the material balance equation for a reactor.

d. List any two advantages of batch reactor.

e. List any four application of fluidized bed reactor.

f. Define autocatalytic reaction. Give one example

g. Define space velocity. Give its unit.

Q.2) Attempt any THREE of the following. **12 Marks**

a. Differentiate between elementary and non-elementary reaction(four points)

b. Derive a relation between total pressure of the system and the partial pressure of the reacting materials.

c. Give the relation between C_A and X_A for constant density and changing density system.

d. Compare MFR and PFR (four points)

Q.3) Attempt any THREE of the following. **12 Marks**

a. List the three important properties of catalyst and explain.

b. At certain temperature, the half-life periods and initial concentration for a reaction are $t_{1/2}$ = 420 s when C_{A0} = 0.405mol / l and $t_{1/2}$ = 275 s when C_{A0} = 0.64mol / l. Find the order of the reaction.

c. Derive the integrated form of rate expression for zero order reaction in terms of conversion. Give the graphical representation also

d. Explain the procedure to find the conversion when MFR's of different sizes are connected in series.

Q.4) Attempt any THREE of the following. 12 Marks

a. In an isothermal batch reactor, the conversion of liquid reactant A achieved in 15 minutes is 75%. Find the space time and space velocity necessary to effect this conversion in a PFR. Consider first order kinetics.

b. For the first order reaction A→R occurring in a variable volume batch reactor, Obtain the relation $-\ln\left(1-\frac{\Delta V}{\epsilon_A V_0}\right) = kt$

c. Draw the graph between fractional conversion and time and give the value of slope also for

   i. Variable volume zero order reaction

   ii. Variable volume first order reaction.

d. Explain the method of feeding when PFR's are connected in parallel.

e. List the general rules to be followed for the best arrangement of a set of ideal reactors.

Q.5) Attempt any TWO of the following. 12 Marks

a. Derive the temperature dependency of rate constant from transition state theory,

b. Explain any four methods of catalyst preparation with eg.

c. After 8 minutes in a batch reactor, reactant (C_{A0} = 1 mol / l) is 80% converted and after 18 minutes conversion is 90%. Find the rate of reaction (k and order both). Check for zero order, first order and second order.

Q.6) Attempt any TWO of the following. 12 Marks

a. Derive the performance equation of constant volume MFR. Give the graphical representation of design equation.

b. A batch reactor is used to convert A→R. The rate of reaction is given in the table. Estimate the time required for the concentration to drop from C_{A0} = 1.3 moles / l to C_A = 0.3 mole/ l .

C_A mol /l	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.3	2.0
$-r_A$ Mol/l.minute	0.1	0.3	0.5	0.6	0.5	0.25	0.1	0.06	0.05	0.045

c. A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = k C_A^2$ takes place with 50% conversion in MFR. Find the conversion if the reactor is replaced by PFR of equal size-all else remaining unchanged.

Scheme - I

Sample Test Paper - I

Program Name : **Chemical Engineering**
Program Code : **CH**
Semester : **Fifth**
Course Title : **Chemical Reaction Engineering**
Marks : **20**

22512

Time: 1 Hour.

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) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a. Define rate constant. Give the unit of rate constant for second order reaction.

b. List the types of multiple reactions.

c. Define fractional conversion x_A

d. Draw the graph of concentration and time for irreversible reaction in series, give the value of slope also.

e. For the gas phase reaction A→ 3R, initially reactant contain 50 mole% A and 50 mole% inert. Find C_A

f. For Zero order reaction, derive $t_{½} = C_{A0}/ 2k$

Q.2 Attempt any THREE. **12 Marks**

a. Define activation energy. Explain the role of activation energy in chemical reaction.

b. Rate constant at 27ºC is $0.001min^{-1}$ and at 37ºC is $0.002min^{-1}$. Find the activation energy of reaction?

c. Explain the method of isolation and method of initial rates used in the partial analysis of rate equation.

d. List the factors to be considered while designing a reactor. Give the material balance equation for batch reactor.

e. Explain the procedure for integral method of analysis of data.

f. Define half-life. Give the mathematical expression.

Scheme - I

Sample Test Paper - II

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Fifth**
Course Title : **Chemical Reaction Engineering**
Marks : **20**

22512

Time: 1 Hour.

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) Preferably, write the answers in sequential order.

Q.1 Attempt any FOUR. **08 Marks**

a. Define holding time. Give its unit.

b. Give two advantages of PFR.

c. Give the graphical representation for the design equation of constant volume batch reactor.

d. List the methods to prevent hot spot formation in a fixed bed reactor.

e. Explain the role of promoters in catalysis.

f. List two methods of catalyst regeneration.

Q.2 Attempt any THREE. **12 Marks**

a. Explain the procedure to determine the best arrangement of different size MFR's in series to achieve a specified conversion of feed.

b. Derive the design equation for PFR.

c. A reaction with stoichiometry A→R is to be carried out in a MFR. Find the size of MFR needed for 75% conversion of feed stream of 1200 moles / l at 1.2 moles / l. Take k= $15hr^{-1}$.

d. Compare packed and fluidised bed reactor based on the following points

   i. Recovery units required.

   ii. Isothermal operation

   iii. Size of catalyst

   iv. Regeneration of catalyst

e. Draw the nature of graph $(1/-r_A)$ Vs X_A for the following arrangements.

   i. Two different size PFR connected in series.

   ii. Two different size MFR connected in series.

f. Give the advantages of MFR.