Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCCH 4305

Sixth Semester Regular Examination – 2014

CHEMICAL REACTION ENGINEERING

BRANCH : CHEM

QUESTION CODE : F 230

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

(a) Differentiate between elementary and non-elementary reactions.

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

(c) A gas mixture in a closed vessel contains 50 mole % A and 50 mole % inert at a pressure of 10 atm and temperature of 150°C. Use ideal gas law to calculate C_{A0}.

(d) Derive the rate equation for nth order reaction.

(e) State the advantages of semi-batch reactor.

(f) What is the significance of Damkohlernumber ?

(g) "For a given duty and for all the positive reaction orders, the size of CSTR is always larger than the PFR". Comment on the statement.

(h) Define the recycle ratio.

(i) How does (k_1/k_2) affect the product distribution.

(j) A certain reaction has a rate given by :

$$-r_A = 0.005\ C_A^2,\ mol/cm^3.min$$

If the concentration is to be expressed in mol/lit and time in hours, what would be the value of rate constant ?

P.T.O.

2. (a) The primary reaction occurring in the homogeneous decomposition of nitrous oxide found to be :

$$N_2O \rightarrow N_2 + (½)\, O_2$$

with rate : $-r_{N2O} = k_1 [N_2O]^2/(1 + k'[N_2O])$

Devise a mechanism to explain this observed rate. 8

(b) Define chain reactions with suitable example. 2

3. A parallel liquid phase reaction

$$A \xrightarrow{k_1} R, \quad A \xrightarrow{k2} S$$

has the rate constants $k_1 = 5h^{-1}$ and $k_2 = 0.8h^{-1}$. Find the moles of R produced in 15 min. Take $C_{A0} = 8.5$ mol/l and $C_{R0} = C_{SO} = 0$. 10

4. A plug flow reactor (2 m^3) processes an aqueous feed 100 l/min containing reactant A (C_{A0} = 100 mol/l). The kinetics of this reversible reaction is represented by :

$$A \leftrightarrow R, -r_A = (0.04\ min^{-1})\, C_A - (0.01\ min^{-1})\, C_R$$

Find the equilibrium conversion and the actual conversion of A in the reactor. 10

5. 100 l/h of radioactive fluid having a half-life of 20h is to be treated by passing it though two ideal stirred tanks in series. The volume of each stirred tank in series is 40,000 liters. In passing through this system how much has the activity decayed ? The reaction follows the first order kinetics. 10

6. Discuss in detail the pore diffusion resistance with surface kinetics. 10

7. A gas A, decomposes irreversibly to form a gas C as per thereaction : $A \rightarrow 2C$. The decomposition of A is a first order reaction which is carried out in an isothermal constant pressure batch reactor. Derive an expression for the volume of the system as a function of time. Assume that the reacting gases behave ideally. 10

8. Write short notes on any **two** : 5×2

(a) Variable volume batch reactor

(b) Design procedure for CSTR

(c) Autocatalytic reactions

(d) Space velocity and space time.