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

Total number of printed pages – 2

B. Tech

CPCH 7306 (Old)

Sixth Semester (Back) Examination – 2013

CHEMICAL REACTION ENGINEERING

BRANCH : CHEM

QUESTION CODE : B335

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.
Assume suitable notations and any missing data wherever necessary.

1. Answer the following questions : 2×10

   (a) State two differences between elementary and non-elementary reactions.

   (b) At 500 K the rate of reaction is ten times the rate at 400 K. Find the activation energy for this reaction from Arrhenius law.

   (c) Derive a relation between the total pressure and partial pressure of the reaction : $N_2O_4 \rightarrow 2\,NO_2$.

   (d) Give a comparison between integral and differential methods.

   (e) Differentiate between constant volume and variable volume batch reactors with suitable examples.

   (f) State some advantages and disadvantages of batch reactors.

   (g) Define space time and space velocity.

   (h) Define recycle ratio.

   (i) What are the factors which affect the rate of reaction ?

   (j) State Transition State Theory.

2. Derive the integrated rate equation for first order reaction in terms of concentration and second order reaction in terms of conversion. 10

3. (a) Derive the performance equation for an ideal batch reactor. 5

P.T.O.

(b) In case of first order reaction, show that the time required for 75% conversion is double the time required for 50% conversion. 5

4. Compare mixed flow reactor with plug flow reactor for first order reaction. 10

5. (a) A polymerization reaction occurs at constant temperature in a homogeneous phase. For initial monomer concentrations of 0.3, 0.5, and 0.9 mol/l, 30% of the monomer reacts in 40 minutes. Find the reaction rate. 5

(b) After 8 minutes in batch reactor, reactant is 80% converted and after 18 minutes the conversion is 90%. Find the rate expression to represent this reaction if $C_{AO} = 1$ mol/l. 5

6. (a) The gas phase decomposition of azo-methane

$$(CH_3)_2N_2 \rightarrow C_2H_6 + N_2$$

proceeds with rate $r_{N2} = k_1 [AZO]^2/(1 + k' [AZO])$, where AZO = azo-methane. Devise a mechanism to explain this rate. 5

(b) Phosphine decomposes when heated as per the reaction

$$4\ PH_3(g) \rightarrow P_4(g) + 6\ H_2(g).$$

At a given instant the rate at which phosphine decomposes is 2.4×10^{-3} mol/l.

(i) Express the rate in three different ways using differential notation and show the relationship between them.

(ii) What is the rate of formation of (a) P_4 and (b) $6H_2$? 5

7. Derive the performance equation for CSTRs in series. 10

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

(a) Plug flow reactor

(b) Autocatalytic reactions

(c) Fluidized bed reactor

(d) Equilibrium conversion under adiabatic conditions.
