6th Semester Regular / Back Examination 2015-16
CHEMICAL REACTION ENGINEERING
BRANCH : Chemical
Time : 3 Hours
Max Marks : 70
Question Code :W191
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.
Answer all parts of a question at a place.

1. Answer the following questions :   2 x 10
   (a) Define elementary reaction with a suitable example.
   (b) What is the significance of activation energy?
   (c) State the advantages of mixed flow reactor.
   (d) How much faster is the pyrolysis of ethaneat 650°C than at 500°C?Pyrolysis of ethane proceeds with an activation energy of about 300kJ/mol.
   (e) Define Selectivity.
   (f) Differentiate between a plug-flow reactor and a batch reactor.
   (g) The design of reactor gets affected by density variation during the reaction. Comment on the statement.
   (h) Define a constant volume batch system with a suitable example.
   (i) Differentiate between integral and differential analysis.
   (j) State Collision theory.

2. With a neat graphical representation, derive and discuss the integrated rate expression for irreversible bimolecular type second order reaction in terms of concentration as well as conversion.   10

3. (a) Derive the performance equation for the case in which two equal-sizedPFRs are arranged in series.   08
   (b) A gaseous feed with C_{AO} = 100 and C_{BO}= 200 mol/l enters a flow reactor in which the reaction A + B →5R occurs at T_0 = 1000K and P_0 = 5atm. Find ε_A.   02

4. **(a)** Compare the mixed flow reactor with plug flow reactor for the first order reaction. **06**

(b) In a batch reactor, reactant is 70 % converted after 8 min and 90% converted after 18 min. Find the rate expression to represent this reaction if $C_{AO} = 1$ mol/l. **04**

5. **(a)** The rate of reaction triples on doubling the concentration. Find the reaction order. **03**

(b) An aqueous solution of ethyl acetate is to be saponified with sodium hydroxide. The initial concentration of ethyl acetate is 5 g/l and that of caustic is 0.1 N. The values of second order rate constant at 0°C and 20°C are 0.235 and 0.924 (l/mol)(min^{-1}) respectively. Calculate the time required to saponify 95 % ester at 40°C if the reaction is irreversible. **07**

6. Derive and explain graphically in details, the performance equation for steady-state mixed flow reactor for constant as well as for variable density systems. **10**

7. **(a)** For an initial monomer concentration of 0.04 and 0.8 mol/l, 20% of the monomer gets disappeared in 34 min in a homogeneous isothermal liquid polymerization. What is the rate expression for the disappearance of the monomer? **04**

(b) What reaction schemes and conditions could be suggested to have maximum concentration of R for the following parallel reactions?

$$A+B \rightarrow R \text{ (desired)}, \quad r_R = 25.e^{-273/T}.C_A^{0.5}C_B$$
$$A+B \rightarrow R \text{ (undesired)}, \quad r_S = 300.e^{-2000/T}.C_A C_B$$

06

8. Write short notes on any **TWO**: **5 x 2**
(a) RTD measurement
(b) Space time and space velocity
(c) Recycle reactor
(d) Variable volume batch reactor