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Total No. of Questions : 09

B.Tech.(Petroleum Refinary Engineering) (2013 Batch) (Sem.–4)

CHEMICAL REACTION ENGINEERING-I

Subject Code : BTPC-406/BTCH-405

M.Code : 72429

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION A

Q1. Answer briefly :

a) Define rate constant and give its units.

b) Give the physical significance of activation energy.

c) Enumerate the various methods for analyzing the kinetic data.

d) Give the advantages and disadvantages of batch reactor.

e) Differentiate between elementary and non-elementary reaction.

f) Differentiate between conversion and yield.

g) Draw graph between concentration and time for autocatalytic reaction.

h) Give the significance of RTD.

i) What is the effect of temperature on equilibrium conversion ?

j) The half life of a first order reaction A $\rightarrow$ B is 10min. Find the conversion after 50min.

SECTION-B

2. The following data has been obtained for an irreversible reaction A→B carried out in a constant volume batch reactor. Find the reaction order and the reaction rate constant.

Time, t(min)	0	5	10	15	20
Concentration of A, C_A (mol/lit)	4.0	2.33	1.1	0.33	0.01

3. Derive the performance equation for a batch reactor for constant density first order system. Show it graphically.

4. 50% conversion for a homogeneous liquid phase reaction $A \xrightarrow{k} B; -r_A = kC_A^2$ takes place in a CSTR. Find the conversion if this reactor is replaced with another having volume 4 times that of original reactor. All the other process conditions remain the same.

5. From steady state kinetic runs in a mixed flow reactor, the following data is obtained for the liquid phase homogeneous reaction. Find the space time needed to treat a feed of C_{A0} = 100 mol/m^3 to 90% conversion in a plug flow reactor.

Time, sec	60	35	11	20	11
C_{A0}, mol/m^3	50	100	100	200	200
C_A,mol/m^3	20	40	60	80	100

6. 80% conversion is achieved in a single CSTR wherein 1st order reaction is carried out. Find out how the addition of another similar CSTR in series with the first one will affect conversion of reactant ?

SECTION-C

7. a) Define E, C and F curve. Give interrelationship between them.

   b) Following data has been obtained when a tracer was injected as a pulse into a reactor.

T,min	0	1	2	3	4	5	6	7	8	9	10	12	14
C_{pulse},gm/L	0	2	5	8	10	8	6	4	3	2.5	1.2	0.3	0

Construct an E curve. Determine the fraction of material leaving the reactor that has spent time inside the reactor between 3 & 5 min.

8. For the irreversible first order series reaction ; $A \xrightarrow{k_1} R \xrightarrow{k_2} S$ in a CSTR. Find an expression to calculate i) the time for achieving maximum concentration of R ii) Maximum concentration of R.

9. An elementary irreversible liquid-phase reaction A + B → C is carried out in a CSTR. The molar flow rate of A and B fed to the reactor at a temperature of 300K are 1.25 mol/sec and 1 mol/sec respectively. The reactor is jacketed and the jacket temperature is maintained at 310 K. An agitator contributes a work of 20.9 kW to the reactor. The volumetric flow rate is 5 Lit/sec. Determine the volume of the reactor for 50% conversion of A. Given that

$$C_{pA}=C_{pB}=\frac{40cal}{molK};C_{pC}=\frac{50cal}{molK};=-\frac{60kcal}{mol};\ k(300K)=\frac{0.01lit}{mol.\text{Sec}};E=8\frac{kcal}{mol};$$

$$H_A^{\circ}(298K)=-\frac{20kcal}{mol};H_B^{\circ}(298K)=-\frac{25kcal}{mol};H_C^{\circ}(298K);U.A=75\frac{cal}{\text{sec}.K}$$

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.