M.Tech. Second Semester (Chemical Engineering) (CBS)
13011 : Chemical Reaction Engineering
2 CE 1

P. Pages : 2

Time : Three Hours

0326

AW - 3450

Max. Marks : 80

Notes : 1. Answer **six** question.
2. Question No. **one** is compulsory.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of pen Blue/Black ink/refill only for writing the answer book.

---

1. A reacts with B in aqueous phase to produce R. Stoichiometry of reaction is $A + B \rightarrow 2R$ Reaction is irreversible. The reactor is charged with equal quantities of A, B and also R, so that $C_{A_0} = C_{B_0} = C_{R_0} = 5 \ mol/lit$ following data were collected for the reaction at 25°C. Find the rate equation for this reaction. **15**

time (min)	C_R, (mol/lit)
0	5
41	6.2
75	7.2
127	8.4
162	8.8
194	9.3
267	9.9
368	10.4
410	10.5

2. Substance A react according to second order kinetics 95% conversion is achieved in a single flow reactor. We buy a second reactor identical to first, for same 95% conversion. By how much is the capacity increased if we operate this two reactors in parallel or in series. The reactors are both plug flow. **13**

3. A first order reaction is to be treated in a series of two mixed reactors. Show that the total volume of two reactors is minimum when the reactors are equal in size. **13**

4. What do you understand by vessel dispersion number ? **13**
The following data represents the tracer output concentration measured in continuous response to delta function input in vessel. Calculate the vessel dispersion number.

time (min)	0	6	12	18	24	30	36	42
tracer output concentration g/lit	0	3	5	7	5	3	1	0

5. What are the different types of three phase slurry reactors ? Explain the advantages and disadvantages of slurry reactors over the packed bed reactors in three phase contacting system. **13**

AW - 3450

1

P.T.O

6. Give in detail the design aspects of -
    i) Trickle bed reactor.
    ii) Fluidized bed reactor.　　　　　　　　　　　　　　　　　　　　　　13

7. i) Explain in detail the general characteristics of heterogeneous catalyst.　　13

    ii) Explain the BET method for surface area determination of heterogeneous catalyst.

8. For following fluid particle reaction　　　　　　　　　　　　　　　　　13
    $A_{(g)} + bB_{(s)} \rightarrow Product_{(s)}$

    for particle of unchanging size, obtain the kinetic expression when -
    i) When diffusion through gas film control.
    ii) When reaction between A & B at gas-solid interphase controls.

9. An undesired impurity is to be removed from air by absorption in pure water in counter　13
    current tower.
    Impurity in inlet air = 0.5% (500 Pa)
    Impurity in outlet air = 0.05% (100 Pa)
    Flow rates of gas and liquid are

    $F_{(g)} / A_{CS} = 0.9 \times 10^5 \ mol / (hr.m^2)$

    $F_l / A_{cs} = 12 \times 10^5 \ mol / (hr.m^2)$

    $k_{Ag}a = 0.6 \ mol / (h.m^3 Pa)$

    $k_{Al}a = 0.4 \ hr^{-1}$

    Molar density of liquid is assumed constant at
    $C_T = 56000 \ mol/m^3$.
    $H_A = 15 \ (Pa.m^3)/mol$
    Calculate the height of tower required.

    ****

AW - 3450　　　　　　　　　　　　　　2