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Question Paper Code: 2035099

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Fifth Semester
Chemical Engineering
U20CH502 - CHEMICAL REACTION ENGINEERING -I
(Regulation 2020)
(Graphsheets to be used)

Time: Three Hours Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. On doubling the concentration of the reactant the rate of reaction triples, Find the order of reaction.

2. State Arrhenius equation.

3. What is Space time?

4. List some of the limitations of Batch reactors.

5. What do you mean by multiple reactions?

6. Define the term Selectivity.

7. Draw the graphical representation of energy balance equation for Adiabatic operations.

8. What is standard heat of reaction?

9. What is exit age distribution?

10. What are the reasons for Non ideality in flow patterns?

PART – B (5 x 16 = 80 Marks)

11.(a) Develop a rate equation in terms of conversion for bi molecule reaction of type. (16)

$A+B \rightarrow$ Product

where the concentration of A and B are different ($C_{A0} \neq C_{B0}$)

(OR)

(b) The following kinetic data are obtained in a constant volume batch reactor at 273 ^{0}C using pure gaseous A: (16)

Time, min	0	2	4	6	8	10	12	14	∞
Partial pressure of A (in mm of hg)	760	600	475	390	320	275	240	215	150

The stoichiometry of the decomposition of A is $A \rightarrow 2.5$ S. Determine a rate equation which will satisfactorily fits the data.

12.(a) The laboratory measurements of rate v/s conversion for reactant A are given below compare the volumes of a Mixed Flow reactor and a plug flow reactor required to achieve 60% conversion .The feed conditions are the same in both the cases. The molar flow rate of A entering the reactor is 10 mol/s. (16)

X_A	0	0.2	0.4	0.6	0.8
$-r_A$ mol/(l.s)	0.182	0.143	0.10	0.0667	0.0357

(OR)

(b) Develop the Performance equation for plug flow reactor and also draw the corresponding characteristics curves. (16)

13.(a) Determine an expression for the concentration of reactant in the effluent for the Mixed flow reactors of following cases. (8+8)

i)Unequal size MFR in series

ii)Equal size MFR in series

(OR)

(b) Liquid reactant A produces R and S by the following reaction in parallel: (16)

$A \rightarrow R$ (First order) with rate constant k_1

$A \rightarrow S$ (First order), with rate constant k_2

A feed of aqueous A with $C_{A0}= 1; C_{R0}=0; C_{S0}=0$ (mol/lit) enters a Mixed flow reactor, the space time reacts to produce R and S , and a mixture of A,R and S leaves the reactor. Find exit C_R, C_S and $\tau_1=2$ min, $\tau_2=5$ min knowing the composition in the first reactor $C_{A1}= 0.4; C_{R1}=0.4; C_{S1}=0.2$ Estimate the composition leaving the second reactor.

14.(a) a. An irreversible isomerization reaction is carried out in the liquid phase in a mixed flow reactor. (16)

A→R, first order reaction.

Rate constant at 165^0 C= 0.7 $(h)^{-1}$

Activation energy =120000 J/mol

Heat of reaction= -350 kJ/ kg

Heat capacity of reactants and products = 1.95 kJ/(Kg.K)

Volumetric flow rate= 0.33 m^3/h

Feed temperature=20^0 C

Conversion expected=95%

Determine the reactor size and temperature of the reaction mixture if the reactor is operated adiabatically

(OR)

(b) Explain in detail about Optimum Temperature Progression. (16)

15.(a) Explain about , (16)

i)E curve, C curve, F curve

ii)States of aggregation, Early and Late mixing of fluid

(OR)

(b) The data given below represents a continuous response to a pulse input in to a closed which is too be used as achemical reactor .Evaluate the mean residence time of fluid in the vessel $\bar{t}$, and tabulate and construct the E curve. (16)

t, min	0	5	10	15	20	25	30	35
C_{pulse} g/l (tracer output concentration),	0	3	5	5	4	2	1	0

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