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GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, June – 2021

(Sixth Semester)

BCHPC6020- CHEMICAL REACTION ENGINEERING-II

(Chemical Engineering)

Time: 2 hrs

Maximum: 50 Marks

Answer ALL Questions**The figures in the right hand margin indicate marks.****PART – A: (Multiple Choice Questions)****(1 x 10 = 10 Marks)**

- Q.1. Answer ALL questions** [CO#] [PO#]
- a. Catalyst is a substance, which _____ of a Chemical reaction [CO3] [PO 1]
- (i) Increases the speed (ii) Decreases the speed
- (iii) either increases or decreases (iv) alters the value of K
- b. Carbon particles accumulated on the catalyst used in the gas oil cracking lies in the category of _____ poison [CO3] [PO 1]
- (i) deposited (ii) chemisorbed
- (iii) selectivity (iv) stability
- c. Which of the following reactor gives the maximum gas conversion [CO1] [PO 1]
- (i) Fixed bed reactor (ii) Fluidised bed reactor
- (iii) Semi – fluidized bed reactor (iv) Plug – flow catalytic reactor
- d. Velocity of a reaction depends upon the [CO4] [PO 1]
- (i) nature of the reactants (ii) concentration of the reactants
- (iii) temperature of the reaction (iv) all the above
- e. The rate of reaction does not decrease appreciably as the reaction proceeds in case of [CO4] [PO 1]
- (i) autocatalytic reactions (ii) exothermic reactions
- (iii) endothermic reactions (iv) autothermal reactions
- f. Rate of a chemical reaction is not influenced by the [CO2] [PO 1]
- (i) catalyst (ii) temperature
- (iii) reactants concentration (iv) valency of reactants
- g. Which of the following is not a chemical step in a fluid solid catalytic reaction? [CO2] [PO 1]
- (i) Surface chemical reaction (ii) Adsorption
- (iii) Desorption (iv) Settling
- h. The fractional volume change of the system for the isothermal gas phase reaction [CO3] [PO 1]
- $A \rightarrow 3B$, between no conversion and complete conversion is
- (i) 0.5 (ii) 1
- (iii) 2 (iv) 3
- i. Dispersion number of CSTR is [CO1] [PO 1]
- (i) 0 (ii) 1
- (iii) <1 (iv) ∞
- j. The rate constant of a chemical reaction decreases by decreasing the [CO2] [PO 1]
- (i) pressure (ii) concentration of reactants
- (iii) temperature (iv) duration of reaction

PART – B: (Short Answer Questions)**(2 x 5 = 10 Marks)**Q.2. Answer ALL questions

[CO#] [PO#]

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| a. What is Residence Time Distribution? And explain its importance? | CO1 | PO 1 |
| b. Explain the importance of a catalyst in Chemical Reactions? | CO3 | PO 1 |
| c. What is Thiele Modulus? | CO2 | PO 1 |
| d. What are the Rate controlling mechanisms of shrinking core model of varying size? | CO4 | PO 1 |
| e. Name the experimental methods for determining the Rates of reactions. | CO2 | PO 1 |

PART – C: (Long Answer Questions)**(6 x 5 = 30 Marks)**Answer ANY FIVE questionsMark [CO#] [PO#]
s

3. The response of a biofilter to a tracer test is given as (6) CO1 PO 2

T (min)	1	2	4	6	8	9	10
C (mg/L)	19	16	13	9	5	1	0

Find the E Function and hence determine the mean and variance of the distribution

4. In the reactor the liquid is diffusing at the rate $-r_A = kC_A$, $k=0.307 \text{ min}^{-1}$. Find the fraction of reactant unconverted in the real reactor and compare this with the fraction unconverted in the plug flow reactor of same size. (6) CO1 PO 2
5. Explain the misbehaviour of mixed flow reactors with required plots (6) CO1 PO 1
6. The catalytic reaction $A \rightarrow 4R$ is studied in a plug flow reactor using various amounts of catalyst and 20lt/hr of pure feed at 3.2 atm and 117°C. The concentrations of A in the effluent stream is recorded for the various runs as follows (6) CO1 PO 2

Runs	1	2	3	4	5
Catalyst used, Kg	0.02	0.04	0.08	0.12	0.16
$C_{A,out}$ (mol/l)	0.074	0.06	0.044	0.035	0.029

The experimental data is $C_{A0} = 0.1 \text{ mol/l}$, $F_{A0} = 2 \text{ mol/hr}$, $\epsilon_A = 3$.

Find the rate equation for this reaction using integral method of analysis.

7. What is a Catalyst? Explain the characteristics of catalysed reactions? (6) CO2 PO 1
8. The results of the kinetic runs on the reactions $A \rightarrow R$ made in an experimental packed bed reactor using a fixed feed rate $F_{A0} = 10 \text{ kmol/h}$ are as follows: (6) CO2 PO 2

W, kg catalyst	1	2	3	4	5	6	7
X_A	0.12	0.20	0.27	0.33	0.37	0.41	0.44

(i) find the reaction rate at 40% conversion

(ii) for a feed rate of 400 kmol/h to large scale packed bed reactor, find the

amount of catalyst needed for 40% conversion.

(iii) find the amount of catalyst that would be needed in part (ii) if the reactor employed a very large recycle of product stream.

9. Explain shrinking core model for particles of fixed size. (6) CO4 PO 1
10. A batch of spherical solids (of single size) is treated by gas in a uniform environment. Solid is converted to a firm non-flaking product according to Shrinking Core Model. The conversion is 87.5% in reaction time of one hour and conversion is complete(100%) in 2 hours. Determine the rate controlling mechanism. (6) CO4 PO 2

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