Ref. No.: Ex/FTBE/PC/B/T/225/2025

B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING

SECOND YEAR SECOND SEMESTER EXAM 2025

Subject: CHEMICAL ENGINEERING KINETICS Part-1 (50) FM-100 Time- 3hrs

Answer question no 4 and any two from the following

1. In a microbial laboratory, three test tubes containing microbial cultures are placed in three hot baths, maintained at different temperatures 60^0C, 70^0C and 80^0C respectively. The following values of time-temp combination with respect to the no. of microorganisms (N) have been determined from the experiment. (20)

For 60^0C		**For 70^0C**		**For 80^0C**	
Time, t (s)	No. of microorganism, N	Time, t (s)	No. of microorganisms, N	Time, t (s)	No. of microorganisms N
0	10^7	0	10^7	0	10^7
30	10^5	30	10^5	30	$5x10^4$
60	10^4	60	$5x10^3$	60	10^3
120	10^3	120	10^2	120	550
180	500	180	50	180	150
300	10	300	1	300	1

Calculate the time required for the reduction of microorganisms to 1 in 1000 at 75^0C.

2. What are different types of reactor can be design on the basis of contacting pattern. Reactant **A** decomposes in a batch reactor, $A \longrightarrow B$
The composition of A in the reactor is measured at various times with results shown in the following columns 1 and 2. Find a rate equation using the integral method to represent the data. (3+17)

Time (t, s)	**Concentration (C_A, mol/liter)**
0	**$C_{A0} = 10$**
30	**8**
50	**7**
70	**5**
90	**3**
110	**2**
130	**1**

3. The irreversible reaction
   A+B= AB, Has been studied kinetically, and the rate of formation of product has been found to be well correlated by the following rate equation
   $r_{AB}= kC^2_A$.....independent of C_B
   What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consist of an association of reactant molecules and that a chain reaction does not occur? (20)

4. What are different types of intermediates we may postulate which has been suggested by the chemistry of the materials for explaining the kinetics of nonelementary Reaction? (10)

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B.E. FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING EXAMINATION 2025 (2nd Year, 2nd Sem)

Subject: CHEMICAL ENGINEERING KINETICS (FTBE/PC/B/T/225)

Time: 1hr. PART II Full Marks: 50

Q.4 is compulsory and answer any two from the following:

Q.1. **5×3= 15**

(i) How the heterogeneous reaction is different from homogeneous reactions?
(ii) For a Gas-Solid system, if the solid particle is surrounded by a gas film, show the steps involved for such heterogeneous reaction schematically.
(iii) Estimate the ε_A for the reaction $4\mathbf{A} \rightarrow 3\mathbf{R}$ containing 35% inert in the feed?
(iv) Estimate the molar feed rate of gaseous reactant A (mol/hr) if 48 lit/hr. pure A with concentration 200 mol/m^3 is fed to the reactor?
(v) Evaluate the concentration of pure gaseous reactant A (mol/lit) if it is fed to the reactor at 3.2 atm and at 117°C

Q.2. Derive the concentration profile of the reactant A inside a purely single cylindrical pore of length L with initial concentration of A at the pore mouth equals to C_{As}. Also estimate the concentration of A at the midway of such cylindrical pore with Thiele modulus value equals to 0.3 **9+6 =15**

Q.3. Write short notes on the following: **5×3 = 15**
(i) Thiele modulus (ii) Performance equation of catalytic reactor (iii) Catalyst poisoning

Q.4. There are two different catalytic reactions to form the same product R as shown below: Both the reaction occurs in a PFR type fluidized reactor utilizing same catalyst but with different conditions of the gaseous reactant A . Both the reaction was occurred at total pressure 4 atm. and at 107° C. For scheme 1, pure A is to be fed but for scheme 2, feed must contain 25% inert. For both the scheme, molar feed rate of A is kept constant at 2 kmol/hr. Estimate (i) the amount of catalyst to achieve 70% conversion of A for both the scheme, respectively (ii) If the catalyst cost Rs. 10,000/kg., then which scheme would be preferable for the same conversion?

$A \rightarrow R$ $-r_A = 98$ (lit/kg. cat-hr) C_A **15+5=20**