GIET UNIVERSITY, GUNUPUR – 765022

B. Tech (Fifth Semester Regular) Examinations, December – 2023

21BCHPC35002 – Chemical Reaction Engineering- I

(Chemical)

Time: 3 hrs | Maximum: 70 Marks

Answer all questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. A certain reaction has a rate given by $-r = 0.005C^2$, mol/cm^3 min. If the concentration is to be expressed in mol/liter and time in hours, what would be the value and units of the rate constant?	CO2	K4
b. If $-r_A = -\frac{dC_A}{dt} = 0.2\ \frac{mol}{lit.sec}$, when $C_A = 1.5\ \frac{mol}{lit}$, what is the rate of reaction when C_A=10 mol/lit for a zero order reaction?	CO2	K2
c. Calculate the rate of reaction for a reactant A for which concentration changes from 0.2 mole/l to 0.12 mole/l in 2 minutes.	CO2	K3
d. Derive the expression for conversion in terms of concentration	CO1	K2
e. Which is the most favorable contacting pattern to get maximum R in among PFR and MFR? Justify the answer.	CO2	K4

PART – B **(15 x 4 = 60 Marks)**

Answer ***ALL*** questions	Marks	CO #	Blooms Level
2. a. Write the classification of chemical reaction based on different modes?	7	CO1	K1
b. A rocket mixture burns a stoichiometric mixture of fuel (liquid hydrogen) in oxidant (liquid oxygen). The combustion chamber is cylindrical, 75cm long and 60 cm in diameter and the combustion process produces 108 kg /sec of exhaust gases. If the combustion is complete, find the rate of reaction of hydrogen and of oxygen.	8	CO2	K4
(OR)			
c. Describe about the different intermediates used in chemical reaction with examples.	7	CO1	K2
d. Ahuman being (75 kg) consumes about 6000 kJ of food per day. Assume that the food is all glucose and that the overall reaction is $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6CO_2 + 6H_2O$, $-\Delta H_r = 2816$ kJ. Find man' metabolic rate (the rate of living, loving and laughing) in terms of mole of oxygen used per m^3 of person per second.	8	CO2	K3
3.a. Derive an expression for C_{Rmax}, in a series reaction of A → R → S, with the rate constants for first order reactions K_1 and K_2 are 5 and 2 min^{-1} respectively.	7	CO2	K3

b.	Derive the performance equation for irreversible first order reaction of variable volume batch reactor.	8	CO2	K2
	(OR)			
c.	In a batch reactor, reactant is 70% converted after 8 min and 90% converted after 18%. Find the rate expression to represent this reaction of C_{A0}= 1 mol/lit	7	CO2	K3
d.	Liquid A decomposes by second-order kinetics, and in a batch reactor 50% of A is converted in a 5-minute run. How much longer would it take to reach 75% conversion?	8	CO2	K3
4.a.	A zero order reaction (A → R) with rate constant 10 occurs in a plug flow reactor. Find the volume required to achieve 90 % conversion with initial concentration of reactant 100 mol/lit and volumetric flow rate of reactant 25 lit/min.	7	CO2	K3
b.	Derive the performance equation for designing an ideal batch reactor.	8	CO1	K2
	(OR)			
c.	A specific enzyme acts as a catalyst in the fermentation of reactant A. At a given enzyme concentration in aqueous feed stream (25 lit/min), find the volume of PFR needed for 90% conversion of reactant A (CA0 = 1 mol/lit). The kinetics of the fermentation at this enzyme concentration is given by $A \xrightarrow{\text{enzyme}} R, \quad -r_A = \frac{0.1C_A}{1+0.5C_A} \quad \frac{\text{mol}}{\text{lit.min}}$	7	CO2	K4
d.	In a plug flow reactor liquid, a decomposes by first order kinetics. The conversion is 50% of A in a 5-minute run. What will be the time taken for 80% conversion of A?	8	CO2	K3
5.a.	Write short note on autocatalytic reaction.	7	CO1	K2
b.	In a batch reactor, reactant is 70% converted after 8 min and 90% converted after 18%. Find the rate expression to represent this reaction of C_{A0}= 1 mol/lit	8	CO2	K3
	(OR)			
c.	Reactant A in a liquid produces R and S by the following reactions: $A \longrightarrow R$ $A \longrightarrow S$ Both these reactions are first order. A feed with C_{A0} =1 C_{R0} = 0 and C_{S0} = 0 enters in two mixed flow reactors in series (τ_1=2 min, τ_2 =5 min). The composition in the first reactor is C_{A1} =0.4, C_{R1} = 0.4 and C_{S1} = 0.2. Find the composition leaving the second reactor.	15	CO2	K3

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