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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. | **Semester: V**
Branch: Chemical Engineering | **Duration: 3 hrs.**
Course Code: 19CH5DCCR1 | **Max Marks: 100**
Course: Chemical Reaction Engineering - I | **Date: 07.03.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) List the differences between molecularity and order of reaction. **04**

b) Derive the equation for temperature dependency from Collision theory. **08**

c) At 227°C the rate of a bimolecular reaction is 10 times of the rate of reaction at 127°C. Calculate the activation energy from Arrhenius theory for this reaction in kJ/mol. **08**

UNIT - II

2 a) Explain elementary and non-elementary reactions with examples. **05**

b) Illustrate on the types of intermediates formed in non-elementary reactions. **05**

c) Show that the homogeneous decomposition of ozone proceeds with a rate is given by: $-r_{O_3}=k\,[O_3]^2[O_2]^{-1}$ **10**

With the following mechanism

$O_3 \rightleftharpoons O_2 + O^*$

$O^* + O_3 \rightarrow 2O_2$

UNIT - III

3 a) Explain integral method of analysis for batch experimental data with relevant graphs. **10**

b) First order homogeneous gaseous decomposition $A \rightarrow 2.5R$ is carried out in an isothermal Batch reactor at 2 atm with 20% inert present and the volume increases by 60% in 20 minutes. In a constant volume reactor, find the time required for the pressure to reach 8 atm if the initial pressure is 5 atm., 2 atm. of which consists of inert. **10**

OR

4	a)	Derive the performance equation (design equation) for the batch reactor and mixed flow reactor.	**10**
	b)	A homogeneous liquid phase reaction A→R, $-r_A = kC_A^2$ takes place with 50% conversion in a mixed reactor. What will be the conversion if the original reactor is replaced by a PFR of equal size, all else remaining same?	**10**

UNIT - IV

5	a)	Explain the graphical procedure for finding the concentration in a series of two CSTRs.	**08**
	b)	The Conversion for a first order liquid phase reaction A→B in an ideal continuous stirred tank (CSTR) is 50%. If another ideal continuous stirred tank of the same volume is connected in series, find the % conversion at the exit of the second reactor.	**05**
	c)	A first order reaction is taking place in two MFR in series. Show that the total volume will be a minimum, when the two reactors are equal in size.	**07**

OR

6	a)	Discuss the qualitative analysis of product distribution for the first order parallel reaction. $A \begin{matrix} \to R \\ \to S \end{matrix}$ (if R is desired product and S is undesired product)	**08**
	b)	Sketch the contacting patterns in continuous flow operations for various combinations of high and low concentration of reactants for maximizing the desired product.	**04**
	c)	Under appropriate conditions A decomposes as follows A →R → S (k_1=k_2=0.1 min $^{-1)}$. R is produced from 1000 lit/h of feed in which C_{AO}=1 mol/lit. $C_{RO} = C_{SO} = 0$. Estimate the size PFR to maximize the yield of R? What is the concentration of R in the effluent stream from this reactor?	**08**

UNIT –V

7	a)	Elucidate the importance of optimum temperature progression.	**10**
	b)	A reversible elementary reaction of type A⇌R has the following relations for k_1 and k_2. k_1= e $^{(20 -12000/T)}$, and k_2=e $^{(60 -24000/T)}$ Find the reaction temperature to achieve 75% conversion of A at equilibrium.	**10**

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