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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.

Branch: Chemical Engineering

Course Code: 19CH5DCCR1

Course: Chemical Reaction Engineering - I

Semester: V

Duration: 3 hrs.

Max Marks: 100

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.

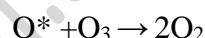
UNIT - I

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



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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

4 a) Derive the performance equation (design equation) for the batch reactor and mixed flow reactor. 10

b) A homogeneous liquid phase reaction $A \rightarrow R$, $-r_A = kC_A^2$ 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 $A \rightarrow B$ 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. 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 $A \rightarrow R \rightarrow S$ ($k_1=k_2=0.1 \text{ min}^{-1}$). R is produced from 1000 lit/h of feed in which $C_{AO}=1 \text{ mol/lit}$. $C_{RO}=C_{SO}=0$. 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 $A \rightleftharpoons R$ has the following relations for k_1 and k_2 . $k_1 = e^{(20 - 12000/T)}$, and $k_2 = e^{(60 - 24000/T)}$ 10

Find the reaction temperature to achieve 75% conversion of A at equilibrium.
