MODEL QUESTION PAPER –I

USN										

18CH53

Fifth semester BE Degree Examination Dec. 2020 / Jan. 2021
CHEMICAL REACTION ENGINEERING –I

Time : 3 hours Max.marks:100

MODULE 1

Q 1.	a.	Differentiate the following (i) molecularity and order of reaction (ii) Elementary and non-elementary reactions (iii) single and multiple reactions	09
Q 1.	b.	Derive the temperature dependent term given by collision theory	06
Q 1.	c.	Milk is pasteurized if it is heated to 63°C for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. Find the activation energy of this sterilization process.	05
Q 2.	a.	Explain about Kinetic Models for Nonelementary Reactions	08
		Experiment shows that the homogeneous decomposition of ozone proceeds with a rate $-r_{O3=} K [O_3]^2 [O_2]^{-1}$ (i) What is the overall order of reaction? (ii) Suggest a two-step mechanism to explain this rate and state how you would further test this mechanism.	12

MODULE 2

Q 3.	a.	What are constant volume batch reactions? Explain the total pressure data useful in constant density system	12
	b.	Derive equation for second order bimolecular reaction for (M # 1)	10
Q 4.	a.	What is variable volume reaction? Explain and derive equation for first order reaction	10
	b.	Find the first-order rate constant for the disappearance of A in the gas reaction 2A + R if, on holding the pressure constant, the volume of the reaction mixture, starting with 80% A, decreases by 20% in 3 min.	10

MODULE 3

Q 5.	a.	Derive performance equation for batch reactor	10
	b.	Explain the advantages, disadvantages and application of Batch, Mixed flow and	10

plug flow reactor

Q. 6. We are planning to operate a batch reactor to convert A into R. This is a liquid reaction, the stoichiometry is A+R, and the rate of reaction is given in Table. How long must we react each batch for the concentration to drop from C_{Ao} = 1.3 mol/liter to C_{Af} = 0.3 mol/liter? 20

C_A	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$	0.1	0.3	0.5	0.6	0.5	0.25	0.10	0.06	0.05	0.045	0.042

Module 4

Q. 7. A first order irreversible reaction A $\rightarrow$R is carried out in a PFR followed by mixed flow reactor in series. The concentration of A in the feed is 1 kmol/m3 and residence time for the reactor is 3600 sec. the specific rate constsnt for the reactor is 1/3600 sec-1. Find the conversion of A at the exit of the system. 20

Q. 8. a. Explain the graphical procedure for calculating exit concentration from the reactor 10

b. Discuss the qualitative treatment about the product distribution of decomposition of A, for reaction of type

A$\rightarrow$R desired product, rate constant K_1

A$\rightarrow$S undesired product, rate constant K_2

Q.9. a. What is adiabetic operation? Explain material balance and conversion for adiabetic operation 10

b. Explain the effeect of temperature on reversible and irreversible rection 10

Q. 10. a. Discuss about optimum temperature progression 10

b. Write a stepwise procedure for an adiabetic batch operation 10

MODEL QUESTION PAPER – II

USN	2	K	L	1	8	C	H	0	0	0

18CH53

Fifth semester BE Degree Examination Dec. 2020 / Jan. 2021
CHEMICAL REACTION ENGINEERING –I

Time : 3 hours Max.marks:100

MODULE 1

Q 1. a. How do you classify chemical reactions Explain 08

b. Define the following (i) rate (ii) mechanism (iii) order (iv) molecularity of chemical reaction 08

c. The pyrolysis of ethane proceeds with an activation energy of about 300 kJ/mol. How much faster is the decomposition at 650°C than at 500 °C? 05

Q 2. a. Explain the temperature dependency term given by transition state theory 10

explain the testing of Kinetic Models of non elementary reactions 10

MODULE 2

Q 3. a. Explain integral and differential method of analysing kinetica data 08

b. The reaction A+B→C is believed to be first order with respect to each reactant. The following data are reported from batch reactor at 20oC, using an initial concentration of B = 0.123 Kmol/m^3, determine whether these data are consistent with given rate equation. If so find rate constant. 12

Q 4. a. Derive equation for first order reversible reaction A=R, with rate constant of forward reaction is k_1 and reverse reaction is k_2 10

b. Write a note on variable volume reaction 04

c. Derive equation for variable volume reaction for second order reaction 06

MODULE 3

Q. 5. a. Derive performance equation for plug flow reactor 08

b. Define space time and space velocity with example 04

c. Explain the advantages and disadvantages of batch reactor 06

Q. 6. A high molecular weight hydrocarbon gas A is fed continuously to a heated high temperature mixed flow reactor where it thermally cracks (homogeneous gas reaction) into lower molecular weight materials, collectively called R, by a stoichiometry approximated by A →5R. 20

By changing the feed rate different extents of cracking are obtained as follows:

F_{A0}, millimol/hr	300	1000	3000	5000
$C_{A,out}$, millimol/liter	16	30	50	60

The internal void volume of the reactor is V = 0.1 liter, and at the temperature of the reactor the feed concentration is CAo = 100 millimol/liter. Find a rate equation to represent the cracking reaction.

Module 4

Q. 7. a. For first order reaction, prove that the system of n equal sized mixed flow reactor connected in series tends to behave as a plug flow reactor as $n \rightarrow \infty$ 10

b. An irreversible homogeneous liquid phase reaction $A \rightarrow B+C$ is carried in two isothermal flow reactor of 100 L capacity each operating at 60oC and exit conversion of both the reactor are operated in series when (i) both the reactors are back mixed reactors (ii) an ideal PFR followed by an back mixed rectors 10

Q.8. a. A graphical procedure for finding the outlet composition from a series of mixed flow reactors of various sizes for reactions 10

b. Discuss the qualitative treatment about the product distribution of decomposition of A, for reaction of type

$A \rightarrow R$ desired product, rate constant K_1

$A \rightarrow S$ undesired product, rate constant K_2

Q. 9. a. Derive the expression heat of reaction and temperature for the reaction 10

$aA \rightarrow rR + sS$

b. What is adiabetic operation? Explain material balance and conversion for adiabetic operation

Q. 10. a. Sketch and explain the different ways of representing the relationship of temperature, composition and rate of reaction 10

b. Derive an expression for effects of temperature on heat of reaction from thermodynamics. 10