Model Question Paper-1 with effect from 2019-20 (CBCS Scheme)

USN

Fifth Semester B.E. Degree Examination
Subject Title Chemical Reaction Engineering

TIME: 03 Hours   **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module -1	***Bloom's Taxonomy Level**	**Marks**
Q.01	a	What is rate of the reaction explain the factors affecting the rate of the reaction.	L1,L2	08
	b	Derive the rate equation for second order reaction and show the nature of the graph.	L2,L3	12
		OR		
Q.02	a	Explain the temperature of rate of reaction dependency from Arrhenius law.	L2,L3	12
	b	The activation energy of a chemical reaction 17,982 cal/mol in the absence of catalyst, and 11,980 cal/mol with a catalyst. By how many times will the rate of the reaction will grow in the presence of a catalyst, if a reaction proceeds at 25^0 C?	L3,L4	08
		Module-2		
Q. 03	a	Derive the performance equation for Continuous Stirred Tank reactor indicating proper material balance.	L2,L3	10
	b	In an isothermal Batch Reactor, the conversion of a liquid reactant A achieved in 13 min is 70%. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor.	L2,L3	10
		OR		
Q.04	a	Compare the performance of mixed flow reactor with that of plug reactor for first order reaction kinetics.	L3	12
	b	Derive the equation for unequal size mixed flow reactor in series	L2,L3	08
		Module-3		
Q. 05	a	Explain the RTD analysis in CSTR.	L1,L2	12
	b	Explain the pulse input experiment for finding E curve.	L2,L3	08
		OR		
Q. 06	a	Derive the relation between E and F curve.	L2,L3	08
	b	The data given below represent a continuous response to a pulse input into a vessel which is to be used as a chemical reactor. Calculate the mean residence time of the fluid in the vessel, tabulate and construct the E curve.	L3,L4	12

t,min	0	5	10	15	20	25	30	35
C_{pulse}, g/l (tracer output concentration)	0	3	5	5	4	2	1	0

		Module-4		
Q. 07	a	Explain the types of enzyme specificities with examples.	L1,L2	08
	b	Derive Michaelis –Menton Equation	L2,L3	12
		OR		

Q. 08	a	Explain the following.	L2,L3	10
		1) Enzyme Active site,		
		2) Free and bound enzyme,		
		3) Allostoric enzyme ,		
		4) Eadie –Hofstee plot and		
		5) Lineweaver Burk plot		
	b	What is enzyme inhibition .Explain competitive and uncompetitive inhibition	L1,L2	10
Module-5				
Q. 09	a	Discuss the kinetics of growth associated and non growth associated products formation.	L1,L2	12
	b	Write a note on Leudeking –Piret model.	L1,L2	08
OR				
Q. 10	a	Explain about the media requirements for fermentation process.	L1,L2	12
	b	Explain the steps of media formulation for optimal growth.	L1,L2	08

*Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.

CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data

CO-2: Design of performance equations for the different reactors

CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors

CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometry

CO-5: Describe medium requirements and media formulation for the optimal bio process

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q1	a	L1,L2	CO-1	PO1
	b	L2,L3	CO-1	PO1
Q2	a	L2,L3	CO-1	PO1
	b	L3,L4	CO-1	PO1
Q3	a	L2,L3	CO-2	PO3
	b	L2,L3	CO-2	PO3
Q4	a	L3	CO-2	PO3
	b	L2,L3	CO-2	PO3
Q5	a	L1,L2	CO-3	PO3
	b	L2,L3	CO-3	PO3
Q6	a	L2,L3	CO-3	PO3
	b	L3,L4	CO-3	PO3

Q7	a	L1,L2	CO-4	PO7
	b	L2,L3	CO-4	PO7
Q8	a	L2,L3	CO-4	PO7
	b	L1,L2	CO-4	PO7
Q9	a	L1,L2	CO-5	PO7
	b	L1,L2	CO-5	PO7
Q10	a	L1,L2	CO-5	PO7
	b	L1,L2	CO-5	PO7

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Fifth Semester B.E. Degree Examination
CHEMICAL REACTION ENGINEERING

TIME: 03 Hours   Max. Marks: 100

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
          02. Draw the relevant figures wherever necessary.
          03. Report the dimensions for the calculated values in the problems given

		Module – 1	**Marks**
Q.1	**(a)**	Illustrate the following terms with the suitable examples i) Reaction Kinetics (ii) Elementary reaction (iii) Non- Elementary reaction (iv) Rate of Reaction (v) Equilibrium Constant.	10
	(b)	Prove that the time taken by first order reaction to finish 75% conversion is double the time required to complete its half-life. Also obtain the kinetic rate expressions for the first order reaction in terms of concentration, conversion and half-life.	10
		OR	
Q.2	**(a)**	Illustrate the temperature dependency of rate and rate constant of the reaction using Arrhenius and Collision theory.	10
	(b)	The reaction started with 0.5 mol/lit has rate constant 1.5min-1.Tabulate the value of unreacted concentration, conversion and reacted concentration at 0.1 min, 0.4 min and 0.8 min. Hence perform the reaction balance. (perform this problem via tabular column)	10
		Module – 2	
Q.3	**(a)**	Establish the differences among the various types of Industrial reactors and hence illustrate the their advantages and disadvantages	10
	(b)	The reaction having the rate equation $-r_A = 0.01 *_{CA}^{0.5}$ is carried out in CSTR and PFR with $C_{A0} = 0.1$mol/lit. Determine and compare the space time required by the CSTR and PFR possessing flow rate of 1 lit/ min using analytical method.	10
		OR	
Q.4	**(a)**	Obtain the performance equation for Batch, and PFR reactor along with the neat graphs associated	10
	(b)	A second order is carried out in CSTR to give 90 % conversion. Explore the possible advantage of using the second CSTR in series by assuming that both reactors possess equal Space time. Also in the above mentioned reactor configuration determine the intermediate conversion if the final conversion from the reactor is 90%.	10
		Module – 3	

| Q.5 | (a) | With the neat sketch explore the various reasons for Non Ideal flow in a reactor system and hence explain the concept of Exit age distribution. | 10 |

	(b)	With the neat sketch mention the various techniques used to apply the tracer to analyze the non-ideal condition of the reactor. Also list out the properties of the tracer.	10
		OR	
Q.6	**(a)**	Mention the properties of tracer. Also derive the correlation that exists between C,E,F curves	10
	(b)	Determine the values of E-age, and plot the E-Curve for the following data. And hence evaluate the principle of normalization used in Non-ideal flow analysis. <table><tr><td>t (Sec)</td><td>C_{pulse} (g/lit)</td></tr><tr><td>0</td><td>0</td></tr><tr><td>5</td><td>3</td></tr><tr><td>10</td><td>5</td></tr><tr><td>15</td><td>5</td></tr><tr><td>20</td><td>4</td></tr><tr><td>25</td><td>2</td></tr><tr><td>30</td><td>1</td></tr><tr><td>35</td><td>0</td></tr></table>	10
		Module – 4	
	(a)	Stating the typical enzyme reaction mechanism, obtain the the Michaelis-Menton equation used for enzyme kinetics	10
Q.7	**(b)**	Stating the reaction mechanism derive the kinetic rate expression for the competitive Inhibition.	10
		OR	
Q.8	**(a)**	Determine the various ways of determining the MichaelisMenton parameters along with the graphical representation.	10
	(b)	Stating the reaction mechanism derive the kinetic rate expression for the Non-competitive Inhibition	10
		Module – 5	
Q.9	**(a)**	Mention the role of various component in fermentation medium and enumerate its significance	10
	(b)	Assume that experimental measurement for certain organism have shown that cells can convert two third (wt/wt) of the substrate carbon to biomass. Calculate the stoichiometric coefficient for the following biological reactions. C_6H_{34} + $aO_2 + bNH_3 \rightarrow c(C_{4.4}H_{7.3}N_{0.86}O_{1.2}) + dH_2O + eCO_2$. Also calculate the yield Coefficients $Y_{X/S}$ and $Y_{X/O2}$ for the same	10
		OR	
Q.10	**(a)**	Mention the importance of the media formulation in fermenter for the optimal growth.	10
	(b)	Mention the concept of the growth and Non growth associated product formation microbial kinetics.	10

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	**L1**	CO1	PO1
	(b)	**L4**	CO1	PO2, PO3
Q.2	(a)	**L2**	CO1	PO1
	(b)	**L3**	CO1	PO2, PO3
Q.3	(a)	**L2**	CO2	PO1
	(b)	**L4**	CO2	PO2, PO3
Q.4	(a)	**L2**	CO2	PO2, PO3
	(b)	**L4**	CO2	PO4
Q.5	(a)	**L2**	CO3	PO2
	(b)	**L3**	CO3	PO4
Q.6	(a)	**L2**	CO3	PO2
	(b)	**L4**	CO3	PO4
Q.7	(a)	**L2**	CO4	PO2, PO1
	(b)	**L3**	CO4	PO2
Q.8	(a)	**L2**	CO4	PO2, PO1
	(b)	**L3**	CO4	PO2
Q.9	(a)	**L1**	CO5	PO1
	(b)	**L3**	CO5	PO2
Q.10	(a)	**L1**	CO5	PO1. PO2
	(b)	**L2**	CO5	PO1, PO2

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge):L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6