Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2021

Subject Code:3170501   **Date:10/12/2021**

Subject Name:Chemical Reaction Engineering -II

Time:10:30 AM TO 01:00 PM   **Total Marks: 70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Write a short note on contacting patterns for two-phase systems with neat sketch.	**03**
	(b)	Discuss with neat sketch the selection of model for fluid – particle reactions.	**04**
	(c)	Dilute A diffuses through a stagnant liquid film onto a plane surface consisting of B, reacts there to produce R, which diffuses back into the mainstream. Develop the overall rate expression accounting for both the rate of mass transfer and rate of reaction for the L/S second order reaction $A_{(l)} + B_{(s)} \rightarrow R_{(l)}$ which takes place on flat surface of solid.	**07**
Q.2	**(a)**	Discuss various physical properties of catalyst.	**03**
	(b)	Answer the following in brief. (i) Turnover frequency and dispersion for catalyst. (ii) Monolithic catalyst.	**04**
	(c)	On doubling the particle size from R to 2R the time needed for complete conversion of a particle triples. Determine the contribution of ash diffusion to the overall resistance for particles of size (i) R and (ii) 2R. Neglect the gas film resistance.	**07**

OR

	(c)	Two small samples of solids are introduced into a constant environment oven and kept there for one hour. Under these conditions the 4-mm particle are 58 % converted and the 2-mm particles are 87.5% converted. (i) Find the rate controlling mechanism for the conversion of solids. (ii) Find the time needed for complete conversion of 1-mm particles in this oven.	**07**
Q.3	**(a)**	Discuss various surface reaction mechanism for catalytic reaction with conceptual model.	**03**
	(b)	Derive Langmuir adsorption isotherm for molecular adsorption of hydrogen on catalyst surface.	**04**
	(c)	Write a short note on classification and preparation of catalyst. Also, discuss various methods of catalyst deactivation.	**07**

OR

Q.3 **(a)** Discuss the spectrum of kinetic regimes for porous catalyst surrounded by a reactant. **03**

(b) The reaction mechanism is believed to be **04**

$$I + S \leftrightarrow I.S$$
$$W + S \leftrightarrow W.S$$
$$W.S + I.S \leftrightarrow T.S + S$$
$$T.S \leftrightarrow T + S$$

Derive the rate law assuming surface reaction as rate limiting.

(c) Discuss about the surface area determination of catalysts by nitrogen desorption method. **07**

Q.4 **(a)** State and discuss significance of Hatta modulus in fluid – fluid reaction. **03**

(b) Derive the rate equation for fast reaction with high concentration of liquid reactant in fluid – fluid reaction. **04**

(c) Explain in brief the various kinetics regimes in fluid – fluid heterogeneous reactions. **07**

OR

Q.4 **(a)** Discuss the importance of solubility data for determination of kinetic regime for fluid – fluid reaction. **03**

(b) Discuss the enhancement factor as a function of rate of infinitely fast reaction and maximum possible conversion. **04**

(c) It is proposed to remove CO_2 from air by counter current contact with water at 25 ºC. (i) Calculate the resistances offered by the gas and liquid film (ii) Suggest the simplest form of rate equation for tower design. **07**

Data: $K_g.a$ = 0.8 mol/hr m^3 Pa, $K_l.a$ = 25 / hr, Henry's constant H = 3000 Pa m^3 / mol.

Q.5 **(a)** State the mass transfer correlations for any one of the catalytic reactor. **03**

(b) Write merits and demerits of fluidized bed reactors. **04**

(c) Derive design equation for moving bed reactor catalytic reaction considering deactivation of catalyst as function of time. **07**

OR

Q.5 **(a)** What is meant by interphase effectiveness factor for isothermal catalytic reaction? **03**

(b) Write a short note on Langmuir-Hinshelwood-Hougen-Watson kinetic model. **04**

(c) Write a brief note on experimental reactors for solid catalyzed reactions. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – SUMMER 2022

Subject Code:3170501   **Date:01/06/2022**

Subject Name:Chemical Reactions Engineering II

Time:02:30 PM TO 05:00 PM   **Total Marks: 70**

Instructions:
   1. **Attempt all questions.**
   2. **Make suitable assumptions wherever necessary.**
   3. **Figures to the right indicate full marks.**
   4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Give name of the type of reactor used for fluid-fluid reactions.	**03**
	(b)	Give examples of fluid particle reactions (Non catalytic).	**04**
	(c)	Explain Progressive Conversion model for fluid particle reaction.	**07**
Q.2	**(a)**	What is the role of catalysts in reaction system? How will it enhance the rate of reaction?	**03**
	(b)	Derive rate equation for fluid-fluid reaction for straight mass transfer	**04**
	(c)	Derive LHHW model with surface reaction as the rate controlling mechanism for the first order reversible reaction.	**07**
		OR	
	(c)	Write in detail about the various methods for preparation of catalysts.	**07**
Q.3	**(a)**	Give significance of Effectiveness factor for solid catalyzed reaction.	**03**
	(b)	Explain poison and promoter for catalyst with example.	**04**
	(c)	Discuss in detail about slurry reactor kinetics.	**07**
		OR	
Q.3	**(a)**	Explain Turn over frequency and Selectivity of catalysts.	**03**
	(b)	Write in brief about the criteria for rate controlling steps in fluid particle reaction.	**04**
	(c)	Discuss advantages and disadvantages of fluidized bed reactor over fixed bed reactor.	**07**
Q.4	**(a)**	Discuss about the Monolithic catalyst.	**03**
	(b)	Define: 1) Catalysts 2) Accelerator 3) Coking 4) Sintering	**04**
	(c)	Derive BET equation for surface area of catalysts.	**07**
		OR	
Q.4	**(a)**	Discuss various physical properties of catalyst.	**03**
	(b)	Discuss the effect of Henry's constant value on the solubility of gas in liquid.	**04**
	(c)	Derive Langmuir adsorption isotherm for molecular adsorption of hydrogen on catalyst surface.	**07**

Q.5 **(a)** Give examples for various fluid-fluid reactions. **03**

(b) How can Hatta number be used to decide the type of contacting device for fluid –fluid reactions. **04**

(c) State various experimental methods for determining rates in solid catalyzed reaction. **07**

OR

Q.5 **(a)** Write in brief on how solubility data cam help to predict the kinetic regime for fluid -fluid reactions. **03**

(b) Discuss Segregation model in brief. **04**

(c) Derive the rate equation for fluid–fluid reaction in the case of instantaneous irreversible reaction with higher concentration of constituent B. **07**

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