Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VII EXAMINATION – WINTER 2025

Subject Code:3170501 Date:24-11-2025

Subject Name:Chemical Reactions 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.**
5. **Notations used in this paper have conventional meaning and need no clarifications**

			Marks
Q.1	**(a)**	Explain classification of catalysts.	03
	(b)	Discuss different kinetic regimes for fluid-fluid systems.	04
	(c)	Discuss various methods for preparation of catalyst.	07
Q.2	**(a)**	Explain significance of Hatta number.	03
	(b)	Define: 1) Sintering 2) Promoters 3) Inhibitors 4) Poisons	04
	(c)	In slurry reactor pure reactant gas is bubbled through liquid containing suspended catalyst particles. Initially the reactant gas which enters the liquid must diffuse through the liquid film into the main body of liquid, and then through the film surrounding the catalyst particle. At the surface of particle reactant yields product according to first order kinetics. Derive an expression for the rate of reaction in terms of resistances encountered in the reactor.	07
		OR	
	(c)	Ram and Rima performed roasting of spherical solid particles containing B isothermally in an oven with gas of constant composition. Solids were converted to form non-flaking product according to the SCM as follows $A(g) + B(s) \rightarrow R(g) + S(s)$ C_A=0.01 kmol/m^3 The density of solid B is 20 kmol/m^3.From the following conversion data (by chemical analysis) or core size data (by slicing and measuring), Ram proposed ash layer controlling while Rima proposed gas layer as the rate controlling mechanism for the transformation of solid from the kinetic data show below,	07

dp (mm)	XB	Time (sec)
1	0.3	2
1	0.75	5

Q.3	**(a)**	Discuss various physical properties of catalyst.	03
	(b)	Describe Nitrogen desorption method for surface area determination of catalyst.	04
	(c)	Derive the time-conversion-radius relationship for shrinking-core model for spherical particles of unchanging size when chemical reaction controls.	07

OR

Q.3	**(a)**	Give some industrial examples of fluid particle reactions.	03
	(b)	Explain Langmuir adsorption isotherm with its assumptions.	04
	(c)	Discuss differential experimental reactor to determine kinetics for solid catalyzed reactions.	07
Q.4	**(a)**	Explain monolithic catalyst.	03
	(b)	Discuss the importance of solubility data for determination of kinetic regime for fluid – fluid reaction.	04
	(c)	It is proposed to remove CO_2 from air by counter current contact with water at 25 ^oC. calculate 1) the resistance offered by the gas and liquid film. 2) suggest the simplest form of rate equation for tower design. K_ga = 0.8 mol/hr- m^3 -Pa, K_la = 25 hr^{-1}, H= 3000 Pa-m^3/mol	07

OR

Q.4	**(a)**	Explain factors to consider in selecting a contactor for fluid-fluid reactor design.	03
	(b)	State and discuss significance of Thiele modulus in solid-catalyzed reactions.	04
	(c)	Distinguish between fixed bed reactor and fluidized bed reactor.	07
Q.5	**(a)**	Discuss 7 steps involved in solid catalyzed reaction.	03
	(b)	Write a short note on trickle bed reactor.	04
	(c)	Explain Langmuir Hinshelwood Hougen Watson model for solid catalyzed gas phase reaction.	07

OR

Q.5	**(a)**	State the various types of tower and tank contactors for gas – liquid reaction.	03
	(b)	Discuss in detail about slurry reactor kinetics.	04
	(c)	The decomposition of cumene is carried out over the platinum catalyst to form benzene and propylene. Draw a conceptual model depicting the sequences of the steps in this reaction and derive the rate law if surface reaction is the rate limiting	07

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