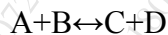


- N.B. : (1) Question No. 1 is compulsory.  
 (2) Solve any three questions from the remaining questions.  
 (3) Assume suitable data wherever necessary.

Q 1. Answer the following questions: **(20)**

- (a) Differentiate between Packed bed & fluidized bed reactors.
- (b) What are the first, second and third moments of RTD.
- (c) The Thiele modulus for a first order isothermal reaction for a flat plate geometry catalyst is found to be 2. Calculate the catalyst effectiveness factor.
- d) Enlist various steps involved in a solid catalyzed reaction.

Q.2.(a) Derive Langmuir-Hinshelwood type of rate equation for the reaction –



Where desorption of C is rate controlling step. **(10)**

- (b) A feed comprising of 20% of 1mm particles, 30% of 2 mm particles & 50% of 4 mm passes through a rotating tubular reactor where it reacts with gas to yield a hard solid product according to the SCM with reaction step is rate controlling. The time required for complete conversion of 4 mm particles is 4 h. Determine the residence needed in the tubular reactor for; a) 100 % conversion of solids    b) 75 % conversion of solids.

**(10)**

Q.3. (a) Derive an expression to calculate time required for complete combustion of particle, when resistance through the gas film is controlling. **(10)**

(b) Explain in detail the contacting patterns in fluid- fluid reactions. **(10)**

Q.4. (a) The data given below represent a continuous response to a pulse input into a closed vessel which is to be used as a chemical reactor. Calculate the mean residence time of fluid in the vessel. Tabulate & construct E Curve. **(10)**

t, min	0	5	10	15	20	25	30	35
C <sub>pulse</sub> , g/l (tracer output concentration)	0	3	5	5	4	2	1	0

(b) Calculate the time required to burn to completion spherical particles of graphite (radius 12 mm, bulk density 2.4 g/cc) in a 12% oxygen stream at 900°C and 1 atm. Assume gas film resistance to be negligible. Surface reaction rate constant =  $k'' = 25 \text{ cm/s}$  (10)

Q.5. (a) The catalytic reaction  $A \rightarrow 3R$  is run in packed bed reactor at 3.5 atm & 115°C. It is desired to treat 1500 mol/hr of pure A 3.5 atm to 32 % conversion the following rate concentration data are available.

$C_A, \text{Mol/l}$	0.04	0.06	0.075	0.09
$-r_A \text{ Mol/(h KgCata.)}$	3.5	5.7	7.2	8.8

Determine amount of catalyst needed in a packed bed reactor. (10)

(b) Write short notes on Trickle Bed and Slurry Reactor (10)

Q.6. Answer the following questions . (Any four) : (20)

- Explain pulse input experiment for RTD measurement.
- What is the significance of HATTA Modulus?
- Define true, apparent and bulk density for a catalyst bed.
- What do you mean by SCM & PCM?
- Write short note on Tanks in Series Model

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