

(3 Hours)

[Total Marks: 80]

N.B. : (1) Question No. 1 is compulsory.

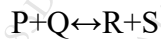
(2) Solve any three questions from the remaining questions.

(3) Assume suitable data wherever necessary.

Q 1. Answer the following questions:

(20)

- Explain the different sorts of behaviours of reacting solid particles in heterogeneous fluid solid noncatalytic reactions.
- Explain Pulse input experiment for RTD measurement.
- What is significance of Hatta number in fluid fluid reactions?
- Differentiate between Physical adsorption & Chemical adsorption.

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

Where desorption of R is rate controlling step.

(10)

- 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.3. (a) Develop conversion time relationship for Shrinking spherical particles when Chemical reaction control.

(10)

- Explain in detail the contacting patterns in fluid- fluid reactions.

(10)

Q.4. a) The effluent concentration readings given below represent a continuous response to a pulse input into a closed vessel.

t, min	0	1	2	3	4	5	6	7	8	9	10	12	14
C Pulse g/m ³	0	1	5	8	10	8	6	4	3	2.2	1.5	0.6	0

This vessel is to be used as a reactor for decomposition of liquid A.



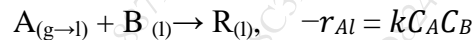
$$-r_A = k C_A, \quad k = 0.10 \text{ min}^{-1}$$

Calculate the mean conversion of reactant A in the real reactor using segregation model

(10)

- (b) A moving grate is continuously fed with feed consisting of 30% of 50 μm radius particles, 40% of 100 μm radius particles & 30% of 200 μm radius particles. The feed is fed in the form of thin layer & moves on the grate in cross current fashion to the flow of reacting gas. The time required for complete conversion is 5, 10, & 20 minutes for three sizes of particles. Find the conversion of solids on the grate for residence time of 8 minutes over the moving grate. (10)

- Q.5.** (a) Gaseous A absorbs and reacts with B in liquid according to



in a packed bed.

- Calculate the rate of reaction
- Determine the location of the major resistance (gas film, liquid film, and bulk liquid) and behavior in the liquid film at a point in the reactor.

where $p_A = 100$ Pa and $C_B = 100$ mol/m³ liquid.

$$k = 10^8 \text{ m}^3 \text{ liquid/mol.h}$$

$$H_A = 1.0 \text{ Pa m}^3 \text{ liquid/mol}$$

$$k_{Ag} = 0.1 \text{ mol/(h.m}^3 \text{ of reactor. Pa)}$$

$$k_{Al} = 100 \text{ m}^3 \text{ liquid/(m}^3 \text{ reactor.h)}$$

$$a = 100 \text{ m}^2/\text{m}^3 \text{ reactor}$$

$$f_l = 0.01 \text{ m}^3 \text{ liquid/m}^3 \text{ reactor}$$

$$D_{Al} = D_{Bl} = 10^{-6} \text{ m}^2/\text{h} \text{ For } E_i < M_H/5, \text{ consider instantaneous reaction and } E \approx E_i \quad (10)$$

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

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

- Write short note on Tanks in Series model
- Sketch the concentration profile for fluid fluid reaction if it is slow reaction (Assume reaction is between gaseous A and liquid B). Show the concentration profile for 1) High C_B & 2) Low C_B
- Define true, apparent and bulk density for a catalyst bed.
- Write short note on Shrinking core model and Progressive conversion model?
- Define Residence Time Distribution (RTD) and explain significance of $E(t)$ curve.