

16/05/2025 TE CHEMICAL SEM-VI C-SCHEME CRE-II QP CODE: 10086006

(3 Hours)

[Total: 80]

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

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

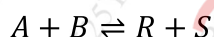
(3) Assume suitable data wherever necessary.

Q 1. Answer the following questions:

(20)

- (a) Write a short note on the Shrinking core model and the Progressive conversion model..
- (b) What are the first, second and third moments of RTD.
- (c) What is the significance of Hatta number in fluid fluid reactions?
- (d) Write a short note on the Fluidised bed reactor.

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



Where the adsorption of B is rate rate-controlling step.

(10)

- (b) Calculate the time required to burn to completion spherical particles of graphite (radius 12 mm, bulk density 2.4 g/cc) in a 14 % oxygen stream at 900°C and 1 atm. Assume the gas film resistance to be negligible. Surface reaction rate constant, $k'' = 25 \text{ cm/s}$.

(10)

Q.3. (a) Develop a conversion time relationship for shrinking spherical particles 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_{Pulse} g/l (tracer output concentration)	0	3	5	5	4	2	1	0

(b) Spherical solid particles containing 'B' are roasted at a constant temperature in an oven with a constant gas composition. Solids are converted to give a firm non-flaking product according to the Shrinking core model (SCM). From the following conversion data, determine the rate-controlling mechanism for the transformation of solid. (10)

Data:

d_p, mm	X_B	t, s
2	0.875	1
1	1	1

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

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

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

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

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

- Write a short note on the Tanks in Series model
- Draw the kinetic regime for i) slow reactions, no mass transfer resistance.
ii) Instantaneous reaction with low C_B
- Differentiate between Physical adsorption & Chemical adsorption.
- Differentiate true density, apparent density and bulk density
- Explain the Pulse input experiment for RTD measurement