Q. P. Code: 18467

Duration: 3 hours **Total Marks:80**

N.B. (1) Question No.1 is compulsory.
(2) Attempt any **three** questions from remaining.
(3) Assume suitable data wherever necessary with proper justification

Q.1 a) Describe Brunauer-Emmett-Teller (BET) method for determination of surface area (05)

Q.1 b) Discuss different controlling mechanisms in Non catalytic heterogeneous reactions (05)

Q.1 c) What is the significance of Hatta number in case of fluid fluid reactions (05)

Q.1 d) Find the conversion in a commercial reactor for a first order reaction if it closely resembles Tanks in Series model (05)
Data: Variance of Tracer distribution=45 min^2
Mean residence time=15 min
Rate constant= 0.3 min^{-1}

Q.2 a) Derive the conversion time expression for the case of gas film controlling resistance in a gas solid non catalytic reaction? Assume Shrinking core model with unchanging particle size. (10)

Q.2 b) A feed consisting (10)
30% of 50-μm-radius particles
40% of 100-μm-radius particles
30% of 200-μm-radius particles
is to be reacted in a fluidized bed steady state flow reactor constructed from a vertical 2-m long 20-cm ID pipe. The fluidizing gas is the gas phase reactant, and at the planned operating conditions the time required for complete conversion is 5, 10 and 20 min for the three sizes of feed. Find the conversion of solids in the reactor for a feed rate of 1 kg solids/min if the bed contains 10 kg solids. The solids are hard and unchanged in size and weight during reaction.

Q.3 a) Develop Langmuir-Hinshelwood type of rate equation for (14)

$$A + B \rightleftarrows C + D$$

When the rate of adsorption of A is rate controlling Step

Q.3 b) Write short note on reactors used for solid fluid non catalytic heterogeneous reactions (06)

TURN OVER

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Q.4.a) How much catalyst is needed in a packed bed reactor with very large recycle rate (assume mixed flow) for 35% conversion of A to R for a feed of 2000 mol/h of pure gaseous A at 3.2 atm and 117^{0}C if the stoichiometry and rate are given by (10)

$$A \rightarrow 4R \qquad -r_A = 96.55\left(\frac{l}{h.kg\ cat}\right)C_A$$

Q.4.b) Write short note on Fixed Bed vs Fluidized Bed reactor (10)

Q.5 The following data have been reported as a result of our effort to determine the distribution of residence time in packed bed reactor. (20)

Time, t min	0	4	8	12	16	20	24	28	32
Effulent tracer concentration (gms/lit)	0	2	3.5	4.5	5.5	4.6	3.4	2.1	0

1) Plot C(t) , E (t) and F(t) curve.
2) Calculate mean residence time
3) Calculate Variance and standard deviation.
4) Find the fraction of material that has spent time between12 min and 16 min in the reactor.

Q.6 a) Gaseous A absorbs and reacts with B in liquid according to (14)

A(g→l) +B (l) → R(l), $-r_{Al} = kC_AC_B$

In a packed bed at a point in the reactor where p_A= 100 Pa and C_B =1mol/m^3 liquid

a) Calculate the rate of reaction in mol/(h.m^{3}of reactor)
b) Resistance offered by the main body of liquid

k= 10 m^3 liquid/(mol.h)
H_A= 10^5 Pa m^{3}liquid/mol
$k_{Ag}a$ =0.10 mol/(h.m^{3}reactor.Pa)
$k_{Al}a$ = 100 m^{3}liquid/(m^{3}reactor.h)
f_l= 0.01 m^3 liquid/m^3 reactor
a=100 m^2/m^3 reactor
$D_{Al} = D_{Bl}$= 10^{-6} m^2/h
For $M_H < 0.02$, infinitely slow reaction.

Q.6 b) For the gas-liquid reaction of the type (06)

$$A_{(gorl)} + bB_{(l)} \rightarrow R \qquad -r_A = kC_AC_B$$

Discuss the reaction regime and give their rate expressions with proper diagrams for the following case :Fast Reactions with low C_B

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