SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

46

ROLL No: | | | | | | | | | | | | | Total number of pages:[2]

B.Tech. -CHE/ 6th Sem

Chemical Reaction Engineering-II

Subject Code:BTCH-601A

Paper ID:

Time allowed: 3 Hrs **Max Marks: 60**

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**
- **Additional instructions, if any**

PART A (10x 2marks)

Q. 1. Short-Answer Questions:

a) What is the basic difference between homogenous & heterogeneous reactions?
b) What are Supported catalyst?
c) Differentiate between Activated & Non-activated Chemisorption.
d) Define the phenomenon of Catalysis involved in Monolithic Catalysts.
e) What is Shrinking core model for spherical particles?
f) What do you mean by 'Film Conversion parameter M_H'?
g) What is the significance of Thiele Modulus M_T related to Solid- Catalyzed reactions.
h) What is two film theory for fluid-fluid reactions?
i) What is difference between Film & Particle ΔT.
j) What is a differential reactor?

PART B (5×8marks)

Q. 2. What do you mean by Adsorption isotherm? What are the various types of Adsorption isotherms & explain the Langmuir form of adsorption isotherm. CO1

OR

Give the various methods to find the Pore volume distribution and explain any one of them in detail. How the above method can be extended for Bidisperse pore systems? CO1

Q. 3. The decomposition of cumene to form benzene and propylene by catalytic reaction is CO1

$$C_6H_5CH(CH_3)_2 \rightarrow C_6H_6 + C_3H_6$$

Show a conceptual model depicting the sequence of steps in this platinum - catalyzed reaction and develop a rate equation for its decomposition.

OR

The true density of the solid material in an activated alumina particle is 3.675 g/cm^3. The density of particle determined by mercury displacement is 1.547. The surface area by adsorption measurement is 1.75m^2/g. From this information compute the pore volume per gram, the porosity and the mean pore radius of the particle. The bulk density of the bed of alumina particles in a 250 cm^3 graduate is 0.81 g/cm^3. What fraction of the total volume is void space between the particles & what fraction is the void space within the particles? CO1

Q. 4. Calculate the time needed to burn to completion particles of graphite (R_0 = 5mm, ρ_B = 2.2 gm/cm^3, K_S = 20 cm/s.) in an 8% oxygen stream. For high gas velocity used assume that film diffusion does not offer any resistance to transfer and reaction. Reaction temperature is 900°C. CO2

OR

Uniform –sized spherical particles UO_3 are reduced to UO_2 in a uniform environment with the following results. CO2

t, hr	0.180	0.347	0.453	0.567	0.733
XB	0.45	0.68	0.80	0.95	0.98

If the reaction follows shrinking core model, find the controlling mechanism & a rate equation to represent this reduction.

Q. 5. Explain how would you design an isothermal packed bed reactor using integral kinetic data. Write the performance equation and briefly describe the various terms. CO3

OR

Define the term "Effectiveness Factor".For a First order reaction of the type CO3

A → Products $\quad -r_A'' = -(1/S)(dNA/dt) = k''C_A$

Derive an expression for concentration of reactant & Effectiveness factor for a single cylindrical pore of length L. Represent the results graphically.

Q. 6. Calculate the amount of catalyst needed in a packed bed reactor to achieve 80% conversion of 1000m^3/h of pure gaseous A (C_{A_0} = 100 mol/m^3) for CO4

$A \rightarrow R, \qquad -r_A' = \frac{50\,CA}{1+0.02\,CA} \quad \frac{mol}{hr.kg\ Cat}$

$A \rightarrow R \qquad -r_A' = 8\,CA^2 \quad \frac{mol}{hr.kg\ Cat}$

OR

The catalytic reaction A → 4R is run at 3.2 atm and 117^{0}C in a plug flow reactor which contains 0.01g of catalyst and uses a feed consisting of the partially converted product of 20 lit/hr of pure unreacted A. The results are as follows: CO4

Run	1	2	3	4
CA in mol/lit	0.1	0.08	0.06	0.04
CA out mol/lit	0.084	0.07	0.055	0.038

Find a rate equation to represent this reaction.