

B.TECH SEM – VII (2007 COURSE) (CHEMICAL ENGG.) :
WINTER - 2017

SUBJECT : CHEMICAL REACTION ENGINEERING – II

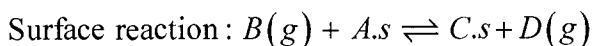
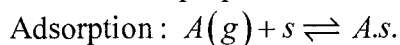
Day : **Friday** Time : **02.30 PM TO 05.30 PM**
Date : **12/01/2018** **W-2017-2543** Max. Marks : 80

N.B.:

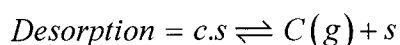
- 1) **Q.No.1 and Q.No.5 are COMPULSORY.** Out of the remaining questions attempt **ANY TWO** questions from each section.
- 2) Answers to both the sections should be written in the **SEPARATE** answer books.
- 3) Draw neat and labeled diagrams **WHEREVER** necessary.
- 4) Use of non programmable **CALCULATOR** is allowed.
- 5) Figures to the right indicate **FULL** marks.
- 6) Assume suitable data if necessary.

SECTION – I

- Q.1** a) Draw contacting patterns for heterogeneous reaction systems. **[04]**
b) Derive unreacted core model for chemical step is rate controlling. **[07]**
c) Give steps in involved in catalytic reactions. **[03]**
- Q.2** a) Gaseous reactant A diffuses through a gas film to the surface of solid B where it reacts with B according to a reversible first order rate, $-r_A^{II} = k^{II} (C_{As} - C_{Ae})$, mol (m².s) where C_{Ae} is the concentration of A in equilibrium with the solid surface. Derive an expression for the rate of reaction of A that accounts for both the mass transfer and reaction steps. **[08]**
b) What is mean by linearizing a nonlinear rate equation? **[05]**
- Q.3** a) In a uniform gas environment, 4mm solid particles are 87.5% converted to product in 5 min according to SCM with ash diffusion step as rate controlling. The solids remain unchanged, in size during reaction. Find the mean conversion that can be obtained in a fluidized bed reactor operating with the same environment as before, using a feed consisting of equal amounts of 2mm and 1mm particles. The mean residence time of solids in a fluidized bed reactor is 30 min. **[10]**
b) Write a note on: Progressive conversion model. **[03]**
- Q.4** Reactant A is adsorbed on the surface of a catalyst and reacts with another component B in the gas phase. The products of the reaction are C adsorbed on the surface and D in the gas phase. The product C is then desorbed from the surface. The proposed mechanism is: **[13]**



$$r_s = k_s \left(P_B C_{A.s} - \frac{C_C P_D}{K_s} \right)$$



$$r_D = k_D \left(C_{C.s} - \frac{P_C C_v}{k_c} \right)$$

For surface reaction controlling show that

$$r_A^{II} = r_s = \frac{C_t k_s K_A (P_A P_B - P_C P_D / K_P)}{(1 + P_A K_A + P_C / K_C)}$$

P.T.O.

SECTION – II

- Q.5** a) Draw kinetic regimes for fluid- fluid reaction. [05]
b) Explain the relationship between E and F curve. [05]
c) Write a note on CVD. [04]
- Q.6** We plan to remove 90% of the reactant present in a gas stream by absorption in water. Find the volume of tower required for counter current operation. [13]
Data: For gas stream
 $F_g = 90000 \text{ mol/h}$ at $\pi = 10^5 \text{ Pa}$.
 $P_A \text{ in} = 1000 \text{ Pa}$, $P_A \text{ out} = 100 \text{ Pa}$.
For the packed bed : $F_l = 900000 \text{ mol/hr}$
 $K_{Aga} = 0.36 \text{ mol / (hr. m}^3 \cdot \text{Pa)}$
 $k_{Al} = 72 \text{ h}^{-1}$
 $H_A = 18 \text{ (pa. m}^3 \text{ / mol)}$, $k = 0.1 \text{ m}^3 \text{ / (mol.h)}$
Molar density $C_T = 55556 \text{ mol/m}^3$
- Q.7** a) Write a note on “Role of RTD in determining reactor behavior. [06]
b) Explain pulse and step experiments. [07]
- Q.8** a) Derive the relation for pore diffusion resistance combined with surface kinetics [10]
for single cylindrical pore and first order reaction.
b) Write a note on chemical vapour deposition (CVD) reaction. [03]

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