Printed Pages : 2 **Roll No.** | | | | | | | | | | | **NCH601**

B. TECH.

THEORY EXAMINATION (SEM–VI) 2016-17

CHEMICAL REACTION ENGINEERING-II

Time : 3 Hours ***Max. Marks : 100***

Note : *Be precise in your answer. In case of numerical problem assume data wherever not provided.*

SECTION – A

1. Define the following: **10 x 2 = 20**

(a) Void fraction.
(b) Catalyst activity.
(c) Solid density and particle density.
(d) Catalyst deactivation.
(e) Catalyst Promoter
(f) Effectiveness factor
(g) Chemisorption
(h) Enhancement factor
(i) Steps of a catalytic reaction
(j) Microbial reaction

SECTION – B

2. Attempt any five of the following questions: **5 x 10 = 50**

(a) (i) Describe a method to determine pore volume in catalyst.
(ii) Define adsorption? Also explain two types of adsorption in a catalytic reaction.

(b) (i) Explain the various types of catalyst deactivation.
(ii) Explain the catalyst preparation method.

(c) (i) Explain shrinking core model with the help of diagram.
(ii) Derive relation between t/τ and X_B for SCM for ash layer diffusion control.

(d) Solid particles of B are roasted with gas A to give a firm non-flaking product according to SCM $A(g)+B(s)\rightarrow R(g)+S(s)$, $C_A=0.01$ kmol/m^3, molar density=20 kmol/ m^3. From the following data, find the rate controlling mechanism.

dp, mm	X_B	t. min
1	1	4
1.5	1	6

(e) Calculate the time needed to burn to completion particles of graphite (R_0=5mm, ρ=2.2gm/cc, k =20 cm/sec) in an 8% oxygen stream. For the high gas velocity used assume that film diffusion does not offer any resistance to transfer and reaction. Reaction Temp = 900^0C, P=1 atm.

(f) What are the factors to be considered in selecting a contactor also discuss the role of Hatta number, M_H .

(g) Mass of catalyst =101.5 gm, vol. of Helium displaced =45.1 cm^3, vol. of Hg displaced =82.7 cm^3.Calculate the pore volume, porosity, solid density and particle density?

(h) (i) Explain Thiele Modulus
(ii) Explain Michaelis-Menten kinetics for enzyme reaction

SECTION – C

Attempt any two of the following questions: **2 x 15 = 30**

3. (i) Write a short note on Microbial Fermentation.

(ii) For the reaction A → 4R, $-r_A=96\ C_A$ mol/kg cat.hr, mixed flow reactor is used for 35% conversion of A to R for a feed rate of 2000 mol/hr of 80% pure A at 3.2 atm and 117^0 C. If $C_{A0}=0.1$ mol/l, determine the amount of catalyst needed.

4. (i) For fluid- fluid reaction derive the rate expressions for different cases of mass transfer and reaction Case A:Instatantaneous reaction with low C_B, Case B:Instatntaneous reaction with high C_B

(ii) Derive the overall rate expression for Cumene decomposition into Benzene and Propylene, assuming single site mechanism and adsorption step be rate controlling.

5. Air with gaseous A bubbles through a tank containing aqueous B. Reaction occurs as follows: $A(g)+2B(l)\rightarrow R(l)$ - $r_A = kC_AC_B^{\ 2}$, $k=10^6$ $m^6/mol^2.hr$ for this system, $k_{Ag}a=0.01$ mol/hr.m^3.Pa $k_{Al}a=20$/hr $D_{Al}= D_{Bl}=10^{-6}$ m^2/hr $f_l=0.98$ $a=20\ m^2/m^3$ $H_A= 10^5$Pa.m^3/mol, pA= $5x10^3$Pa and $C_B=$ 100mol/m^3 Determine the behavior of reaction, location of resistance to reaction and the rate of reaction.