Paper Code: CH-502	**Roll No.**									

B.TECH
FIFTH SEMESTER EXAMINATION, 2016-17
CHEMICAL REACTION ENGINEERING-II

[Time: 3 Hours] [Max. Marks: 100]

Note:- Attempt All questions. All questions carry equal marks. Assume suitable data if required. **Graph paper** will be provided.

1. Attempt any *four* parts of the following: - **(5x4=20)**

(a) Discuss briefly about different types of adsorption processes.
(b) What do you mean by catalyst Sintering/Ageing, Fouling/Coking and poisoning?
(c) Differentiate Non competitive inhibition and Competitive inhibition.
(d) For a liquid-phase reaction of the type A + . . . → products, an experimental CSTR of volume 1.5 L is used to measure the rate of reaction at a given temperature. If the steady state feed rate is 0.015 L s^{-1}, the feed concentration (C_{A0}) is 0.8 mol/L, and A is 15% converted on flow through the reactor, what is the value of ($-r_A$)?
(e) Discuss about determination of rate controlling step for fluid particle reaction.
(f) Describe with neat sketch the fixed bed reactor and fluidized bed reactor.

2. Attempt any *four* parts of the following: - **(5x4=20)**

(a) Show that a large number of CSTR's in series approaches the behaviour of a PFR.
(b) Discuss about "Determination of Surface area for catalysts".
(c) What do you mean by enzyme fermentation and microbial fermentation?
(d) Gaseous A reacts (A → R) in an experimental reactor. From the following conversion data at various conditions, find a rate equation to represent the reaction.(Mixed flow, C_{A0}=10 mol/m^3, W=4gm).

$v_{0,}$ m^3/hr	3	2	1.2
X_A	0.2	0.3	0.5

(e) Discuss K-L model for fluidized bed reactor.
(f) What do you mean by semi batch reactor? Derive the rate equation for semi batch reactors in terms of the concentration.

3. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Derive the rate law expression for heterogeneous reaction taking place on solid surface if adsorption and chemical reaction controls the overall rate.

(b) Derive the Michaelis-Menten kinetics for batch, plug and mixed flow fermentor.

(c) The following kinetic data are obtained in an experimental Carberry type basket reactor using 100 gm of catalyst in the paddles and different flow rates from run to run. Determine the amount of catalyst needed in a packed bed reactor for 75% conversion of 1000 mol A/min of a C_{A0} = 8 mol/m^3 feed (A→R,C_{A0}=10 mol/m^3).

F_{A0},mol/min	0.14	0.42	1.67	2.5	1.25
X_A	8	6	4	2	1

4. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Derive the design equation for non isothermal CSTR and PFR.

(b) Uniform-sized spherical particles UO_3 are reduced to UO_2 in a uniform environment with the following results: If reaction follows the SCM, find the controlling mechanism and a rate equation to represent this reduction.

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

(c) Derive the time-conversion-radius relationship for shrinking-core model for spherical particles of unchanging size when diffusion through gas film controls.

5. Attempt any *two* parts of the following: - **(10x2=20)**

(a) Enzyme E catalyzes the decomposition of substrate A. To see whether substance B acts as inhibitor we make two kinetic runs in a batch reactor, one with B present, the other without B. From the data recorded below

(i) Find a rate equation to represent the decomposition of A.

(ii) What is the role of B in this decomposition?

(iii) Suggest a mechanism for the reaction.

Run 1. C_{Ao} = 600 mol/m^3, C_{EO} = 8 gm/m^3, no B present

C_A	350	160	40	10
t,hr	1	2	3	4

Run 2. C_{Ao} = 800 mol/m^3, C_{EO} = 8 gm/m^3, $C_B = C_{Bo}$ = 100 mol/m^3

C_A	560	340	180	80	30
t,hr	1	2	3	4	5

(b) What is effectiveness factor? Derive a relationship for effectiveness factor and Thiele Modulus for a spherical shell.

(c) The following data are obtained from the adsorption of dinitrogen (N_2) on a sample of carbon black at 77K. Use the equation for the BET isotherm to calculate V_m, the volume of nitrogen adsorbed which corresponds to monolayer. If 1g of carbon black was used in the experiment , Calculate the surface area assuming the area occupied by nitrogen molecule to be 16.2×10^{-20} m^2.

Relative pressure(P/P_0)	0.05	0.10	0.15	0.20	0.25	0.30
Volume of N_2 adsorbed (cm3)	12.4	14.5	16.2	17.6	19.0	20.5