Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015

Subject code: 180501 **Date:15/05/2015**

Subject Name: Chemical Reaction Engineering-II

Time: 10.30AM-01.00PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) Define with suitable examples. **06**

a) Promoter b) Inhibitor c) Carrier
d) Accelerator e) Activity f) Coking/fouling

(b) Derive mechanism using LHHW model for the reaction, A ↔ R (single active centre) when adsorption is rate controlling step. **08**

Q.2 (a) Derive relationship of time required for complete conversion when ash layer is rate controlling using shrinking core model. **07**

(b) What are the applications of 'BET Theory'? Derive the equation to be used for BET application. **07**

OR

(b) What is effectiveness factor? Derive a relationship between effectiveness factor and Thiele Modulus. **07**

Q.3 (a) Reactant gas (U_O = 0.3 m/s, V_O = 0.311 m^3/s) passes upward through a 2 meter diameter fluidized bed (U_{mf} = 0.028 m/s, ε_{mf} = 0.48) containing 7 tons of catalyst (W = 7000 kg, ρ_s = 2100 kg/m^3). Reaction proceeds as follows: **10**

$A \rightarrow R$, $-r_A^{111} = K^{111}C_A$, $K^{111} = 0.8\ m^3/m^3s.s$

Calculate the conversion of reactant.

Data: $C_{AO} = 100$ mole/m^3

$\Delta = 20 \times 10^{-6}\ m^2/s$

$\alpha = 0.33$

$d_b = 0.16$ m

(b) Give merits and Demerits of fixed bed and fluidized bed reactor. **04**

OR

Q.3 (a) Spherical particles of zinc blend of size R = 0.05 mm are roasted in a 8% oxygen stream at 900°C and a 1 atm. Stoichiometry of the reaction is, **07**

$2ZnS_{(S)} + 3O_{2(g)} \rightarrow 2ZnO + 2SO_2$

Assuming that reaction takes place by the shrinking core model.

Calculate the time required for complete conversion of a particle and the relative resistance of ash layer diffusion during this operation.

Data: $\rho_{solid} = \rho_B$ = 4.13 gm/cc

= 0.0425 moles/cc

$K\rho$ = 2 cm/s

Effective diffusivity of gases in the ZnO layer, D_e = 0.08 cm^2/sec.

(b) List out characteristics of good tracer and explain step input experiment for finding F curve. **07**

Q.4 **(a)** The gas phase catalyst reaction A → 4R is studied in a PFR using various amounts of catalyst and 20 liters pure A feed at 3.2 atmosphere and 117°C. The data obtained are as follows. **07**

Run No.	1	2	3	4	5
Catalyst used (kg)	0.02	0.04	0.08	0.12	0.16
$C_{A,out}$ (moles/lit)	0.074	0.06	0.044	0.035	0.029

Find the rate equation for this reaction using integral method of analysis.

(b) What is film conversion parameter? State various criteria of it which is used in the study of fluid-fluid reactions. **07**

OR

Q.4 **(a)** The data given below represent a continuous response to pulse input into a closed vessel which is to be used as chemical reaction. Calculate the mean residence time of fluid in the vessel and tabulate and construct E curve. **07**

t, min	0	5	10	15	20	25	30	35
C_{pulse}, gm/l	0	3	5	5	4	2	1	0

Q.4 **(b)** Explain E, F and C curves with their relation. **07**

Q.5 **(a)** Derive the rate equation for the following gas-liquid instantaneous reaction with low C_B, Include mass transfer and reaction terms in the rate equations. **07**

$$A_{(g)} + b\,B_{(l)} \rightarrow \text{Product}_{(l)}$$

(b) Write short notes on Dispersion Model for the non ideal reactor **07**

OR

Q.5 **(a)** A reaction with dividing baffles is to be used to carry the reaction A---→R, $-r_A = 0.05\ C_A$ mol/l min. Pulse test results are **07**

t, min	0	10	20	30	40	50	60	70
C	35	38	40	40	39	37	36	35

Calculate the conversion assuming plug flow, tank in series model and mixed flow.

(b) Write short notes on Tank in series model for the non Ideal Reactor. **07**

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