Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII EXAMINATION – SUMMER 2016

Subject Code: 180501 **Date: 10/05/2016**

Subject Name: Chemical Reaction Engineering - II

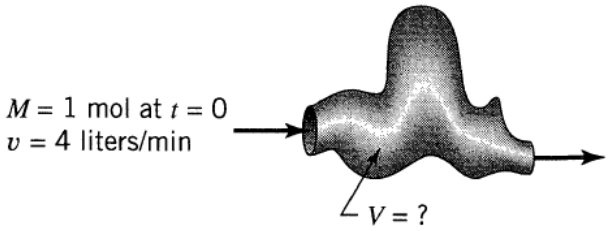
Time: 10:30 AM to 01:00 PM **Total Marks: 70**

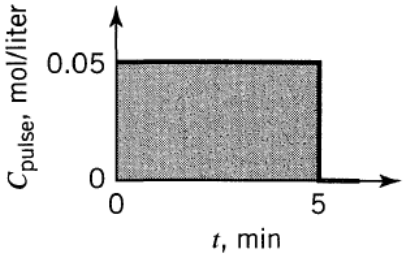
Instructions:

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

Q.1 **(a)** Describe step and impulse input test for determining exit age distribution in non-ideal chemical reactors. **07**

(b) A pulse input to a vessel gives the results shown in below figure: **07**





(1) Check the material balance with the tracer curve to see whether the results are consistent.

(2) If the result is consistent, determine mean residence time $\bar{t}$, volume of reactor V and sketch the **E** curve.

Q.2 **(a)** A pulse tracer test gives the following output curve: **07**

Time, t, min	0	10	20	30	40	50	60	70
Concentration, C, mol/liter	35	38	40	40	39	37	36	35

(1) Draw C versus t curve, and find the area under the C versus t curve.

(2) Draw E versus t curve.

(3) Calculate the mean residence time and variance of the E curve.

(b) Write a short note on Dispersion Model. **07**

OR

(b) Derive Residence Time Distribution Function (RTD) for Tank-in Series model for N-number of CSTR in series. **07**

Q.3 **(a)** Derive the rate equation for straight mass transfer (Absorption) of A in fluid-fluid reaction. **07**

(b) Describe all eight cases for mass transfer and reaction for fluid-fluid reactions with neat sketch. **07**

OR

Q.3 **(a)** Define Enhancement factor and Hatta Modulus for fluid-fluid reactions. **07**

(b) Differentiate between Progressive Conversion Model (PCM) and Shrinking Core Model (SCM) for fluid-particle reactions. **07**

Q.4 **(a)** Derive the time-conversion-radius relationship for shrinking-core model for spherical particles of unchanging size when diffusion through gas film controls. **07**

(b) Describe in details the role of temperature, time, and particle size in determining the rate controlling step for fluid-particle reactions. **07**

OR

Q.4 **(a)** Derive the time-conversion-radius relationship for shrinking-core model for spherical particles of unchanging size when chemical reaction controls. **07**

(b) Spherical solid particles containing B are roasted isothermally in an oven with gas of constant composition. Solids are converted to a form non-flaking product according to the SCM as follows: **07**

$$A_{(g)}+B_{(s)} \rightarrow R_{(g)}+S_{(s)} \qquad C_A=0.01 \text{ kmol/m}^3$$

The density of solid B is 20 kmol/m^3. From the following conversion data (by chemical analysis) or core size data (by slicing and measuring) determine the rate controlling mechanism for the transformation of solid,

dp, mm	**X_B**	**t, min**
1	1.0	4
1.5	1.0	6

Q.5 **(a)** What is effectiveness factor? Derive a relationship between effectiveness factor and Thiele Modulus for first order reaction. **07**

(b) Define with suitable examples, **07**

1) Promoter, 2) Inhibitor, 3) Carrier, 4) Accelerator, 5) Activity, 6) Coking/fouling

OR

Q.5 **(a)** Discuss: physical adsorption and chemisorption. **07**

(b) Describe with neat sketch the fixed bed reactor and fluidized bed reactor. **07**

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