Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH. END SEMESTER MAKE UP EXAMINATIONS 2019

SUBJECT: CHEMICAL REACTION ENGINEERING 2 [CHE 3202]

REVISED CREDIT SYSTEM
(12/06/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:
- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. A liquid phase reaction, 2A → B, $-r_A = kC_A^2$ for which k = 0.01 dm^3/mol.min is carried out at a temperature of 320 K. The feed is pure A with C_{A0} = 8 mol/dm^3. The reactor is non ideal and perhaps can be modeled as two CSTR's with interchange. The reactor volume is 1000 dm^3 and feed rate is 25 dm^3/min. A tracer test was run on this reactor and the results are given below. **06**

C mg/dm^3	112	95.8	82.2	70.6	60.9	45.6	34.5	26.3	15.7	7.67	2.55	0.9
t, min	0	5	10	15	20	30	40	50	70	100	150	200

What conversions can you expect from an Ideal PFR and CSTR?
N_0 = 100 g, v = 25 dm^3/min.

1B. We wish to know the bounds on the conversion for the RTD of this reactor (Question 1A). What are these bounds? **04**

2A. Say a reaction A + 2B → 2C + D is conducted in an adiabatic CSTR, what is the reactor volume and space time necessary to achieve 40% conversion of A? The reaction rate is first order in *A* and second order in B. **06**

Data:

ΔH_R = - 370.1 kJ/mol	T_O = 303 K
Cp_A = 84.5 J/(mol K)	F_{AO} = 10 mol/min
Cp_B = 137 J/(mol K)	F_{BO} = 30 mol/min
Cp_C = 170 J(mol K)	v_0 = 1000 L/min
Cp_D = 75 J/(mol K)	C_{AO} = 0.01 mol/L

$k = 0.090 \exp[(40\ kJ/mol)/R\ (1/303 - 1/T)]\ (L/mol)^2\ (min)^{-1}$

2B. Compare and contrast Physisorption and chemisorption. **04**

3A. With a neat sketch derive the relation between time and conversion for solid shrinking particle when gas film is the rate controlling step. **06**

3B. Derive the BET expression for determining the surface area of a particle. **04**

4A.	Calculate the time required for complete burning of particles of graphite (size: R_o = 5mm, ρ_B = 2.2 g/cc) in an 8% oxygen stream at 900°C and 1 atm. Assume high gas velocity. Rate constant k'' = 20 cm/s.	**06**
4B.	Write a note on slurry reactors kinetics.	**04**
5A.	Find an interim rate expression for the following catalytic reaction when adsorption is the rate controlling step. A $\rightarrow$ B.	**06**
5B.	Explain in brief with plots the eight different cases based on two-film theory in fluid-fluid contact systems.	**04**