Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VI SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, April 2017

SUBJECT: CHEMICAL REACTION ENGINEERING 2 [CHE 306]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **any FIVE full** questions.
- Missing data may be suitable assumed.

1A.	A reactor is used to carry out the reaction A→R, $-r_A = 0.0075C_A$, mol/(lt.s). t (s): 0, 48, 96, 144, 192, 242, 288, 336, 384 C(t) (g/cc): 0, 0, 0, 0.1, 5, 10, 8, 4, 0 Calculate conversion assuming a). Plug flow (PFR) b). Mixed flow (CSTR) c). Ideal PFR with a mean residence time of 260 s.	**10**
1B.	Derive relationship between conversion and RTD data for dead space and bypass model	**10**
2.	A catalyst particle consists of cylindrical pores and a single first order reaction occurs within the pores under isothermal conditions, without any change in volume. Develop expressions to find the concentration profile in the pore and also sketch the concentration profile inside the pore. What is the importance of effectiveness factor?	**20**
3A.	An elementary irreversible gas phase reaction A → B + C is carried out adiabatically in a CSTR filled with catalyst. Pure A enters the reactor at a volumetric flow rate of 20 dm^3/s, pressure of 10 atm and a temperature of 450 K. What weight of catalyst is necessary to achieve 80% conversion? **Data**: $Cp_A = 40$ J/mol.K, $Cp_B = 25$ J/mol.K, $Cp_C = 15$ J/mol.K $\Delta H^o_{fA} = -70$, $\Delta H^o_{fB} = -50$, $\Delta H^o_{fC} = -40$ (all in kJ/mol at 273 K) $k = 0.133 \exp E/R\,(1/450 - 1/T)$ dm^3/kg. cat. sec, E = 31.4 kJ/mol	**10**
3B.	Write a note on Multiple Steady States.	**10**
4A.	Derive the BET surface area equation and explain how it is determined experimentally.	**12**
4B.	Develop an interim rate expression for the following catalytic reaction when surface reaction is the rate controlling step. C → B + P. (Single site mechanism with inhibition)	**08**

5A.	Spherical particle of graphite of size (Ro = 5mm, ρ_B = 2.2 g/cc) is burnt in a 8 % oxygen stream of high velocity at 900 ^oC and 1 atm undergoes the reaction: Using the following data calculate: a) The time required for complete conversion of the particle b) Relative resistance of ash layer diffusion. Rate constant k'' = 20 cm/s.	**10**
5B.	With a neat sketch relate time and conversion for a spherical particle when the controlling resistance is chemical reaction.	**10**
6A.	Explain in detail the Shrinking core and Progressive conversion models	**12**
6B.	Compare and contrast Physisorption and chemisorption	**08**