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 3202]

#### **REVISED CREDIT SYSTEM**

Time: 3 Hours

MAX. MARKS: 100

#### Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitable assumed.

	A reactor is used to carry out the reaction $A \rightarrow R$ , $-r_A = 0.0075C_A$ , mol/(lt.s).											
1A.	t (s)	0	48	96	144	192	242	288	336	384		10
	C(t) (g/cc)	0	0	0	0.1	5 Dlass 4	<u>    10</u>	8	4	0	$(CCTD) \rightarrow 11-1$ DED	10
	with a mean residence time of 260 s											
	Derive relationship between conversion and RTD data for dead space and bypass model										10	
1B.												
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 $A \rightarrow B + C$ is carried out adiabatically in a CSTR filled with catalyst. Pure A enters the reactor at a volumetric flow rate of 20 dm <sup>3</sup> /s, pressure of 10 atm and a temperature of 450 K. What weight of catalyst is necessary to achieve 80% conversion? <b>Data</b> : Cp <sub>A</sub> = 40 J/mol.K, Cp <sub>B</sub> = 25 J/mol.K, Cp <sub>C</sub> = 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 <sup>3</sup> /kg. cat. sec, E = 31.4 kJ/mol									10		
3B.	Write a note	on I	Multi	ple Ste	ady Sta	ates.						10
4A.	Derive the Bl	ET s	surfac	ce area	equati	on and	expla	in how	it is de	etermin	ed experimentally.	12
4B.	Develop an reaction is the	inte e rat	erim te cor	rate e ntrollin	xpressi g step.	ion for $C \rightarrow ]$	r the B + P.	followi (Single	ing cat e site m	talytic 1echani	reaction when surface ism with inhibition)	08

5A.	Spherical particle of graphite of size (Ro = 5mm, $\rho_B = 2.2$ g/cc) is burnt in a 8 % oxygen stream of high velocity at 900 °C 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	