Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (CHEMICAL ENGINEERING)

MAKE UP EXAMINATION, January 2016

SUBJECT: CHEMICAL REACTION ENGINEERING [CHE-307]

REVISED CREDIT SYSTEM

Time: 3 Hours **Max. Marks: 100**

Instructions to Candidates:

- Answer **ANY 5 FULL** questions.
- Missing data may be suitable assumed and indicated properly

1A.	Distinguish: Extensive and Intensive chemical reaction rates. Explain the various ways of defining these rates.	**(06)**
1B.	Explain the differential and integral methods of analysis of kinetic data?. Explain these methods taking a uni-molecular n^{th} order reaction $A \rightarrow$ products as the example.	**(10)**
1C.	What is "half-life"? Explain the half method of kinetic analysis with graph and equation.	**(04)**
2.	We are planning to operate a mixed flow reactor to convert A into R in the liquid phase by the reaction $A \rightarrow R$. The rate vs concentration data is given below. (i)What size of mixed flow reactor is required to achieve 75% conversion of a feed stream of 1000 moles of A/hr with C_{A0}= 1.2 mol /lit? (ii) repeat part (i)with a feed rate of 2000 molA/hr. with C_{A0}=1.2 mol/lit (iii) repeat part (i) with a feed rate of 1000 molA/hr with C_{A0}=2.4 mol/lit to be treated down to final concentration of C_{Af} =0.3mol/lit	**(20)**

C_A (mol/lit)	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**1.0**	**1.3**	**2.0**
$(-r_A)$ (mol/lit..min)	**0.1**	**0.3**	**0.5**	**0.6**	**0.5**	**0.25**	**0.1**	**0.06**	**0.05**	**0.045**	**0.042**

3A.	The saponification reaction NaOH(aq) +CH3COOC2H5→ CH3COONa+C2H5OH follows second order kinetics. A laboratory batch reactor is charged with an aqueous solution containing NaOH and ethyl acetate, both at an initial concentration of 0.1 mol/lit.18% conversion of ethyl acetate is obtained in 15 minutes. For the initial charge containing NaOH and ethyl acetate in equal concentration of 0.2 mol/lit, find the time required to achieve a conversion of 30% in a commercial batch reactor.	**(10)**
3B.	A first order gas phase reaction A→ 3R, is first studied in a constant-pressure batch reactor. At a pressure of 2 atm and starting with pure A, the volume increases by 75% in 15 min. Find the rate constant of the reaction.	**(10)**
4.	The homogeneous gas phase reaction A→ 3R follows second order kinetics. For a feed rate of 4 m3/hr of pure A at 5 atm and 350 deg C, an experimental reactor consisting of a 2.5 cm ID, 2meter long pipe gives 60% conversion of feed. A commercial plant is to treat 320 m3/hr of feed containing 50% of A and 50% inerts at 25 atm and 350 deg C to obtain 80 % conversion.(i) How many 2 meter long and 2.5 cm ID pipes are required?(ii):Should they be placed in series or parallel? Assume: Plug flow in the pipe, negligible pressure drop and ideal gas behavior.	**(20)**
5A.	Considering a first order liquid phase reaction: A→ R , prove the following: (i) the sequencing of 2 CSTRS; a small volume CSTR (V_1) and a larger volume (V_2) CSTR does not matter and the final conversion will be the same, when they are connected in series for the above reaction. (ii)the sequencing of 2 reactors ; a PFR and a CSTR does not matter and the final conversion will be the same, when they are connected in series for the above reaction.	**(12)**
5B.	Show that the CSTR cascade consisting of N number of equal size tanks gives the same performance (same final conversion/concentration) of that of a PFR for the same volume and same initial conditions of C_{AO}, v_o, F_{AO}.	**(08)**
6A.	Consider the elementary consecutive reactions: **A→B→C** with unequal rate constants for both the steps is conducted in a PFR. Derive expressions for τ_{max} and $C_{B\,max}$. Show the variation of concentration of A, B and C with respect to time in a graph in cases of equal rate constants for both the reaction steps, k1=k2	**(12)**
6B.	Suggest the various possible contacting patterns (including both batch & continuous systems) for the following parallel reactions for maximizing selectivity of the desired product D against the undesired product U. List the assumptions. A + 2B → D … (i) 2A + B → U …..(ii)	**(08)**