Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

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MANIPAL INSTITUTE OF TECHNOLOGY

V SEMESTER B.TECH (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, JAN 2016 (MAKE-UP)

SUBJECT: BIOPROCESS AND BIOREACTION ENGINEERING (BIO 311)

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** the questions.
- Missing data may be suitable assumed.

1A.	Write on: i. Elementary and Non elementary reactions ii. Reaction order and rate constant iii. Kinetic modeling	**6**
1B.	The first-order homogeneous gaseous decomposition A → 2.5 R is carried out in an isothermal batch reactor at 2atm with 20% inerts present, and the volume increases by 60% in 20 min. In a constant volume reactor, find the time required for the pressure to reach 8 atm if the initial pressure is 5 atm, 2 atm of which consist of inerts	**4**
2A.	The irreversible reaction A + B =AB has been studied kinetically, and the rate of formation of product has been found to be well correlated by the following rate equation $r_{AB}=K\ C_B^2$ independent of C_B. What reaction mechanism is suggested by this rate expression if the chemistry of the reaction suggests that the intermediate consists of an association of reactant molecules and that a chain reaction does not occur?	**5**
2B.	What do you mean by shifting order reactions? Explain how do you find the kinetics for shifting order reaction types of (i) Shift from low to high order as the concentration drops (ii) Shift from high to low order as the concentration drops	**5**
3A.	A specific enzyme acts as catalyst in the fermentation of reactant A. At a given enzyme concentration in the aqueous feed stream (25 liter/min) find the volume of plug flow reactor needed for 95% conversion of reactant A (CA0 = 2 mol/liter). The kinetics of the fermentation at this enzyme concentration is given by $A \xrightarrow{enzyme} R, \qquad -r_A = \frac{0.1 C_A}{1+0.5 C_A} \ \frac{mol}{liter.\min}$	**5**
3B.	At 650ºC phosphine vapor decomposes as follows: 4PH3 → P4(g) + 6H2, $-r_{phos} = (10\ hr^{-1})C_{phos}$ What size of plug flow reactor operating at 650ºC and 11.4 atm is needed for 75% conversion of 10 mol/hr of phosphine in a 2/3 phosphine-1/3 inert feed ?	**5**
4A.	Pure gaseous A at about 3 atm and 30ºC (120 mmol/liter) is fed into a 1-liter	**5**

	mixed flow reactor at various flow rates. There it decomposes, and the exit concentration of A is measured for each flow rate. From the following data find a rate equation to represent the kinetics of the decomposition of A. Assume that reactant A alone affects the rate. υ_0, liter/min 0.06 0.48 1.5 8.1 C_A, mmol/liter 30 60 80 105 $A \rightarrow 3R$	
4B.	Describe the graphical procedure to find the conversion from a given multiple reactor system of three unequal size MFR's are connected in series.	**5**
5A.	What are the advantages of the Recycle reactor? Write the expression for optimum recycle ratio and represent it graphically for the typical elementary autocatalytic reaction of $A + R \rightarrow R + R$	**5**
5B.	At present we have 90% conversion of a liquid feed (n = 1, CA0 = 10 mol/liter) to our plug flow reactor with recycle of product (R = 2). If we shut off the recycle stream, by how much will this lower the processing rate of feed to the same 90%conversion?	**5**
6A.	Write on applications of the following reactors in bioprocessing industries i. Fed batch reactor ii. Bubble column bioreactor	**5**
6B.	Following data were obtained from a immobilized enzyme packed bed bioreactor during the RTD experiment using KCl as the tracer material. Determine the (i) plot E(θ) vs θ curve (ii) Find the fraction of material coming out from the reactor in the time interval 18 and 26min.	**5**

Time min	0	4	8	12	16	20	24	28	32
Tracer concentration g/cc	0	3	5	5	4	2	1	0	0