Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of MAHE)

V SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2018

SUBJECT: CHEMICAL REACTION ENGINEERING 1 [CHE 3102]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions and any missing data may be suitably assumed.

1A.	An 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: $r_{AB} = kC_B^2$; independent of C_A. 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?	**07**
1B.	Compare the different theories of temperature dependency of a rate equation to obtain the most suitable one.	**03**
2A.	$2A \rightarrow X + 2Y$ is 2nd order with respect to A (gas phase reaction). Reactant A (pure) is introduced into a constant volume batch reactor, the pressure rises by 40% in 3 min. At time t = 0 the total pressure was 1 atm. For constant pressure batch reactor find the time required for the same conversion.	**06**
2B.	Explain in detail the Differential method of analysis of kinetic data.	**04**
3A.	The following liquid-phase reaction is carried out in a CSTR and achieves 50% conversion $A \rightarrow B$, $(-r_A) = k C_A^2$ (i) What will be the conversion if this reactor is replaced by another reactor which is six times as large? All other conditions remain the same (ii) What will be the conversion if the original CSTR is replaced by a PFR of equal volume? All other conditions remain the same State all the assumptions that have been taken into account.	**06**
3B.	Derive the performance equation for an ideal Batch reactor.	**04**
4A.	Substrate A in the liquid phase produces R and S by the following reactions : A → R ; $r_R = k_1 C_A^2$ A → S ; $r_S = k_2 C_A$	**06**

<table>
<tr><td></td><td>The feed (C_{Ao} = 1.0, C_{Ro} = 0, C_{So} = 0.3) enters two mixed reactors in series (τ_1 = 2.5 min, τ_2 = 10 min). Knowing the composition in the first reactor (C_{A1} = 0.4, C_{R1} = 0.2, C_{S1} = 0.7) Find the composition leaving the second reactor.</td><td></td></tr>
<tr><td>4B.</td><td>Discuss about the graphical procedure to find the best set up to achieve a given conversion when unequal sized MFR's (say 2 in number) are connected in series.</td><td>04</td></tr>
<tr><td>5A.</td><td>Carbohydrate A decomposes in the presence of enzyme E. We also suspect that carbohydrate B in some way influences this decomposition. To study this phenomenon various concentrations of A, B, and E flow into and out of a mixed flow reactor (V = 240 cm^3).
(a) From the following data find a rate equation for the decomposition.
(b) What can you say about the role of B in the decomposition?
(c) Can you suggest a mechanism for this reaction?

<table>
<tr><th>C_{A0}, mol/m^3</th><th>C_A, mol/m^3</th><th>C_{B0}, mol/m^3</th><th>C_{E0}, mol/m^3</th><th>v, cm^3/min</th></tr>
<tr><td>200</td><td>50</td><td>0</td><td>12.5</td><td>80</td></tr>
<tr><td>900</td><td>300</td><td>0</td><td>5</td><td>24</td></tr>
<tr><td>1200</td><td>800</td><td>0</td><td>5</td><td>48</td></tr>
<tr><td>700</td><td>33.3</td><td>33.3</td><td>33.3</td><td>24</td></tr>
<tr><td>200</td><td>80</td><td>33.3</td><td>10</td><td>80</td></tr>
<tr><td>900</td><td>500</td><td>33.3</td><td>20</td><td>120</td></tr>
</table>
</td><td>07</td></tr>
<tr><td>5B.</td><td>A first-order liquid phase reaction, 92% conversion, is taking place in a mixed flow reactor. It has been suggested that a fraction of the product stream, with no additional treatment, be recycled. If the feed stream remains unchanged, in what way would this effect conversion?</td><td>03</td></tr>
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