| Reg. No. | | | | | | | | | | |
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# Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

## V SEMESTER B.TECH (CHEMICAL ENGINEERING)

## END SEMESTER EXAMINATIONS, NOV 2017

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.

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| **1A.** | Explain in detail the temperature dependency of a rate equation. Compare the different theories to obtain the most suitable one. | **06** |
| **1B.** | Explain in detail as to how the Partial analysis of a rate equation is used to determine the kinetics? (Hint: for reversible reactions) | **04** |
| **2A.** | $2A \rightarrow X + 2Y$ is $2^{nd}$ 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<br>i) The time required for the same conversion.<br>ii) The fractional increase in volume at that time. | **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<br>$A \rightarrow B$, $(-r_A) = k C_A^2$<br>(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<br>(b) What will be the conversion if the original CSTR is replaced by a PFR of equal volume? All other conditions remain the same<br>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 produce R and S by the following reactions :<br>A → R ; $r_R = k_1 C_A^2$<br>A → S ; $r_S = k_2 C_A$<br>The feed ($C_{Ao}$ = 1.0, $C_{Ro}$ = 0, $C_{So}$ = 0.3) enters two mixed reactors in series ($\tau_1$ = 2.5 min, $\tau_2$ = 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. | **06** |

<table>
<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 $cm^3$).<br>(a) From the following data find a rate equation for the decomposition.<br>(b) What can you say about the role of B in the decomposition?<br>(c) Can you suggest a mechanism for this reaction?<br><br>
<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>
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</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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