Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Sem Examination, November 2018

Course: Chemical Reaction Engineering | **Semester: VII**
Program: B. Tech APE GAS | **Code: CHEG331**
Time: 03 hrs. | **Max. Marks: 100**

Instructions: Answer all the questions of a section <u>at one place and in order</u>. Write legibly.

SECTION A (20 Marks)

S. No.		Marks	CO
Q 1	Derive the performance equation for the mixed flow reactor.	**05**	**CO3**
Q 2	Consider a feed C_{AO}=100, C_{BO}=400, C_{iO}=100 to a steady flow reactor. The isothermal gas phase reaction is $A+3B \rightarrow 6R$. If C_A=40 at the reactor exit, what is C_B, X_A and X_B?	**05**	**CO3**
Q 3	In an isothermal batch reactor 70% of a liquid reactant is converted in 13 min. What space time and space velocity are needed to effect this conversion in a plug flow reactor and in a mixed flow reactor?	**05**	**CO4**
Q 4	A gaseous feed of pure A (2 mol/liter, 100 mol/min) decomposes to give a variety of products in a plug flow reactor. The kinetics of the conversion is represented by A $\rightarrow$2.5 (products), $-r_A = (10\ min^{-1})C_A$ Find the expected conversion in a 22 lit reactor.	**05**	**CO4**

SECTION B (40 Marks)

<table>
<tr><td>Q 5</td><td>An aqueous feed containing A (1mol/liter) enters a 2 liter plug flow reactor and reacts away (2A→R, $-r_A$=0.05 C_A^2 mol/liter.s). Find the outlet concentration of A for a feed rate of 0.5 liter/min.</td><td>10</td><td>CO1</td></tr>
<tr><td>Q6</td><td>We plan to replace our present mixed flow reactor with one having double the volume. For the same aqueous feed (10 mol A/liter) and the same feed rate find the new conversion. The reaction kinetics are represented by A→R, $-r_A = kC_A^{1.5}$ and present conversion is 70 %.</td><td>10</td><td>O2</td></tr>
<tr><td>Q 7</td><td>Derive the performance equations for the recycle reactor.</td><td>10</td><td>CO3</td></tr>
<tr><td>Q 8</td><td>A stream of pure gaseous reactant A (C_{A0} = 660 mmol/liter) enters a plug flow reactor at a flow rate of F_{A0} = 540mmol/min and polymerizes there as follows 3A→R, $-r_A$ = 54 mmol/liter.min. How large a reactor is needed to lower the concentration of A in the exit stream to C_{Af} = 330mmol/liter?</td><td>10</td><td>CO5</td></tr>
<tr><td colspan="4">SECTION-C (40 Marks)</td></tr>
<tr><td>Q 9</td><td>An aqueous feed of A and B (400 liter/min, 100 mmol A/liter, and 200 mmolB/liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by A+B → R, $-r_A$= 200 C_A C_B mol/liter.min. Find the volume of reactor needed for 99.9% conversion of A to product.</td><td>(10 + 10)</td><td>CO3 CO4</td></tr>
<tr><td>Q 10</td><td>We are planning to operate a batch reactor to convert A into R. this is a liquid reaction, the stoichiometry is A→R, and the rate of reaction is given in table below. How long must we react each batch for the concentration to drop from C_{A0}= 1.3 mol/liter to C_{Af} = 0.3 mol/liter?
<table>
<tr><td>C_A, mol/liter</td><td>0.1</td><td>0.2</td><td>0.3</td><td>0.4</td><td>0.5</td><td>0.6</td><td>0.7</td><td>0.8</td><td>1.0</td><td>1.3</td><td>2.0</td></tr>
<tr><td>$-r_A$, mol/liter.min</td><td>0.1</td><td>0.3</td><td>0.5</td><td>0.6</td><td>0.5</td><td>0.25</td><td>0.1</td><td>0.06</td><td>0.05</td><td>0.045</td><td>0.042</td></tr>
</table></td><td>20</td><td>CO5</td></tr>
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