Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Sem Examination, December 2019

Course: Chemical Reaction Engineering **Semester: VII**
Program: B. Tech APE GAS **Code: CHEG331**
Time: 02 hrs. **Max. Marks: 100**

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

SECTION A (60 Marks)

S. No.		Marks	CO
Q 1	Derive an expression for the concentration of reactant in the exit stream from a series of mixed reactors of different sizes. Assume that the reaction follows first order kinetics and the holding time in the i_{th} reactor is τ_i.	**10**	**CO1**
Q 2	The elementary liquid phase reaction A+B → R+S is carried out in a plug flow reactor. For equimolar amounts of A and B ($C_{A0} = C_{BO}$ = 0.9 mol/lit), 94% conversion is achieved in it. If a CSTR, 10 times as large as the plug flow reactor, were arranged in series with the existing unit, which unit needs to be arranged first to enhance the production rate.	**10**	**CO2**
Q 3	A second order irreversible reaction is carried out in a single CSTR which results in 89% conversion of reactant A. If another identical CSTR is connected in series with the first one determine the percentage increase in conversion of the reactant.	**10**	**CO3**
Q 4	Derive the performance equation for recycle reactor.	**10**	**CO4**
Q 5	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?	**10**	**CO1**
Q 6	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 %.	**10**	**CO2**

SECTION-B (40 Marks)

<table>
<tr>
<td>Q 7</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>(20)</td>
<td>CO3
CO4</td>
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<tr>
<td>Q 8</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>
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<td>20</td>
<td>CO5</td>
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