Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination (Online Mode)

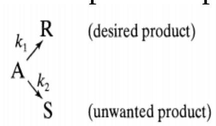
Course: Chemical Reaction Engineering **Semester: VIII**
Program: B. Tech APE GAS **Time : 03 hrs.**
Course Code: CHEG 333 **Max. Marks: 100**

Instructions:

SECTION A

Each Question will carry 5 Marks

S. No.		Marks	CO
Q 1	A first order reaction is to be treated in a series of two mixed reactors. The total volume of the two reactors is a) Minimum when the reactors are of different sizes b) Maximum when the reactors are equal in size c) Minimum when the reactors are equal in size	**5**	**CO5**
Q2	For identical feed compositions, flow rate and for elementary first order reactions, N equal size mixed reactors in series with a total volume V gives the same conversion as a single plug flow reactor of volume V for constant density systems. This is true for a) N = 1 b) N = ∞ c) N >1 d) N<1	**5**	**CO5**
Q3	For the irreversible unimolecular type reaction, A ---- products in a batch reactor, 80% reactant A (C_{A0} = 1 mole/lit) is converted in a 480 second run and conversion is 90% after 18 min. The order of this reaction is a) 1 b) 2 c) ½ d) 3/2	**5**	**CO1**
Q4	Suppose doubling the concentration of a reactant increased the rate of reaction by a factor of 4, and tripling the concentration of the reactant increases the reaction rate by a factor of 9. Then the rate of reaction is proportional to the concentration of the reactant raised to the a) First power b) Second power c) Third power d) Fourth power	**5**	**CO2**
Q5	For a steady state mixed reactor, the space time is equivalent to the holding time for a) Constant fluid density systems b) Variable fluid density systems c) Non isothermal gas reactions d) Gas reactions with changing number of moles.	**5**	**CO3**

Q6	One liter per second of gaseous reactant A is introduced into a mixed reactor. The stoichiometry is A ----- 3R, the conversion is 50% and under these conditions the leaving flow rate is 2 liters per second. The space time for this operation is a) 1 sec b) ½ sec c) 2 sec d) 1/3 sec	**5**	**CO4**
SECTION B **Each question will carry 10 marks**			
Q 7	A 10-minute experimental run shows that 75% of liquid reactant is converted to product by a ½ order rate. What would be the fraction converted in a half-hour run?	**10**	**CO1**
Q8	For irreversible first order series reaction A------ R-------S, the value of rate constants k_1 and k_2 are 0.17 $(min)^{-1}$ and 0.11 $(min)^{-1}$ respectively. Calculate (i) the time at which the concentration of R is maximum and (ii) maximum concentration of R. Take C_{A0} = 1.25 mol/l.	**10**	**CO2**
Q9	Consider a feed with C_{A0} = 100, C_{B0} = 200 and C_{i0} = 100 enters a steady flow reactor in which isothermal gas phase reaction A + 3B ---- 6R takes place. Determine C_B, X_B, X_A at the exit of the reactor if C_A at exit is 40	**10**	**CO3**
Q10	An aqueous feed of A and B (400 liter/min, 100 mmol A/liter, 200 mmol B/liter) is to be converted to product in a plug flow reactor. The kinetics of the reaction is represented by mol 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.	**10**	**CO4**
Q11	Liquid reactant A decomposes as per reaction scheme:  With rate equations: $r_R = k_1 C_A^2$, $K_1 = 0.4\ m^3/(mol.\ Min)$ $r_S = K_2 C_A$, $K_2 = 2\ (min)^{-1}$ An aqueous feed A (CA0 = 40 mol/m3) enters a reactor, decomposes, and a mixture of A, R, and S leaves. Find C_R, and C_S and τ for X_A = 0.9 in a mixed flow reactor. **OR** Find C_R, and C_S and τ for X_A = 0.9 in a plug flow reactor.	**10**	**CO5**
SECTION-C **Each Question carries 20 Marks.**			
Q 12	It is desired to produce 4000 kmol/day of ethylene glycol. The reactor is operated isothermally. A 16.05 kmol/m3 solution of ethylene oxide in water is fed to the CSTR	**20**	**CO5**

	together with an equal volumetric solution of water containing 90% by weight H_2SO_4. If 80% conversion is to be achieved, find the volume of reactor. How many CSTRs, each having volume 3 m3, would be required to if they are arranged in parallel? What is the corresponding conversion? How many CSTRs each having volume 3 m3 would be required to if they are arranged in series? What is the corresponding conversion? The first order reaction rate constant is 0.311 (min)-1. **OR** The elementary irreversible aqueous-phase reaction A + B-----R + S is carried out isothermally as follows. Equal volumetric flow rates of two liquid streams are introduced into a 4-liter mixing tank. One stream contains 0.020 mol A/liter, the other 1.400 mol B/liter. The mixed stream is then passed through a 16-liter plug flow reactor. We find that some R is formed in the mixing tank, its concentration being 0.002 mol/liter. Assuming that the mixing tank acts as a mixed flow reactor, find the concentration of R at the exit of the plug flow reactor as well as the fraction of initial A that has been converted in the system.		