UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Chemical Reaction Engineering I — **Semester : V**
Program: B.Tech (CE+RP) — **Duration : 03 hrs.**
Course Code: CHCE3004 — **Max. Marks: 100**

Instructions: (i) In case of data missing make necessary assumptions.

SECTION A

(Scan and upload) (5Qx 4M = 20 Marks)

Q 1	Enumerate the ways of defining the rate equation.	4	**CO1**
Q 2	For non-elementary reactions, there is a difference between order and stoichiometric coefficients. Justify the statement.	4	**CO1**
Q 3	Write the advantages and disadvantages of CSTR.	4	**CO3**
Q 4	Define ξ_A , Consider a gaseous feed at To = 1000K, Po = 5 atm, C_{Ao} = 100 moles/lit, C_{Bo} = 200 moles/lit enters in a flow reactor in which A +B $\longrightarrow$ 5C occurs. Find ξ_A.	4	**CO2**
Q 5	What is a semi batch reactor? What are the advantages of this reactor?	4	**CO4**

SECTION B

(Scan and upload) (4Qx10M = 40 Marks)

Q 1	Discuss the theory of maximization of rectangles for finding optimum sizes of two mixed reactors in series.	10	**CO5**
Q 2	For A $\longrightarrow$ R $\longrightarrow$ S derive an expression for C_{Rmax} by considering unimolecular type first order reaction. Assume K_1 and K_2 as rate constants.	10	**CO2**
Q 3	A homogeneous liquid phase reaction with the stoichiometry and the kinetics A $\longrightarrow$ S, $-r_A = kC_A^2$, takes place with 50% conversion in a mixed flow reactor. If this MFR is replaced by a PFR of the same size, find the conversion in PFR. All other conditions are remaining unchanged.	10	**CO4**
Q 4	It is required to produce 9.5 kg/s of ethylene by cracking a feed stream of pure etane in a plug flow reactor operated at 1100 K and 6 atm. The cracking reaction is first order with K = 3.07 / s. at 1100 K. $C_2H_6 \longrightarrow C_2H_4 + H_2$ Find the volume of reactor to achieve 80 % conversion of ethane.	10	**CO3**

SECTION-C

(Scan and upload) (2Qx 20M= 40 Marks)

Q 1	Substance A in liquid phase produces R and S by the following reactions A $\longrightarrow$ R, A $\longrightarrow$ S. With $r_R = K_1 C_A^2$ and $r_S = K_2 C_A$. the feed (C_{Ao} = 1.0 mol/lit, C_{Ro} = 0, C_{So} = 0.30 mol/lit) enters two mixed flow reactors in series (τ_1 = 2.5 min, τ_2 = 2.5 min) knowing the composition in the first order (C_{A1} = 0.4 mol/lit, C_{R1} = 0.2 mol/lit, C_{S1} = 0.70 mol/lit), find the composition leaving the second reactor.	20	**CO5**
Q 2	The elementary gas phase reaction $A_3 \longrightarrow 3A$ is carried out in a plug flow reactor. The rate constant at 50°C is 10^{-4} min^{-1} and the activation energy is 85 kJ/mol. Pure A_3 enters the reactor at 10 atm and 127°C and a molar flow rate of 2.5 mol/min. Calculate the reactor volume and the space time required to achieve 90% conversion of A_3. Assume applicability of Arrhenius law.	20	**CO4**