Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Sem Examination, December 2024

Programme Name: B. Tech in Chemical Engineering **Semester : V**
Course Name : Chemical Reaction Engineering I **Time : 3 hr**
Course Code : CHCE 3004 **Max. Marks : 100**
Nos. of page(s) : 3

Instructions: The exam will be <u>OPEN BOOKS, NOTES, and RESOURCE exams</u>. The students are allowed all textbooks, photocopies, handwritten notes, and laptops. <u>NO SHARING OF RESOURCES ARE ALLOWED</u>.

Please make the necessary assumptions and mention them whenever and wherever required. Please read every question very carefully before attempting.

SECTION A [30]

S. No.		Marks	CO
Q1.	You are the team lead, and your team from Ranbaxy is working on developing different drugs. You have divided your team into three groups, each working on different stoichiometric combinations of Active Pharmaceutical Ingredients (APIs) **A and B**. One of the groups approaches you with batch data, kinetic analysis, and a rate equation $\mathbf{-r = kC_AC_B^2}$. However, you are skeptical of the results received and decide to check them. The batch data received is		

time (min)	X_a	X_b
0*T	0	0
0.91*T	0.23	0.08
1.82*T	0.42	0.15
2.73*T	0.54	0.21
3.64*T	0.62	0.25
4.55*T	0.75	0.29
5.45*T	0.82	0.33
6.36*T	0.85	0.36
7.27*T	0.88	0.39
8.18*T	0.92	0.42
9.09*T	0.95	0.45
10*T	0.97	0.49

Here, **T = LAST TWO DIGITS OF SAP ID.**

If the initial concentrations of the APIs A and B are

C_{Ao} = LAST ONE DIGIT OF ROLL NUMBER (kmol/m^3)

C_{Bo} = LAST ONE DIGIT OF SAP ID (kmol/m^3)

	a) Prove the authenticity of the rate law shared by your team member. Also, comment on the kinetic data received. Take all necessary assumptions and mention the same.	**10**	**CO2**
	b) What mistakes do you believe your team members may have made during the kinetic data analysis?	**5**	**CO1**
	c) What conclusions do you draw from the rate equation derived for the process?	**15**	**CO1**
SECTION B [35]			
Q2.	As the team lead, you are required to communicate details on the reactor and its design configuration to Thermo Fisher for fabrication. Your team has been working hard to identify the best combination of reactors to maximize productivity. Your team has shared three possible combinations. Which one will you choose? Give proper justifications. Here, the molar flow rates of A and B are 1 kmol/min each.		
	a) 1 CSTRs of 1000 m^3	**10**	**CO4**
	b) 3 CSTRs of 300 m^3 each	**10**	**CO4**
	c) CSTR 1 of 200 m^3 + CSTR 2 of 300 m^3 + CSTR 3 of 500m^3	**10**	**CO4**
	d) Analyze the possible pros and cons of your choice.	**5**	**CO1**
SECTION C [35]			
Q3.	The fabricated reactor has been received from Thermo Fisher. However, your reactor is not giving the required conversion. You have instructed your team to perform tracer analysis and have received the following data		

t (min)	RTD data
0	0
5	0.07
10	0.15
15	0.23
20	0.32
25	0.42
30	0.52
35	0.62
40	0.7
45	0.77
50	0.84
55	0.9
60	0.95
65	0.98
70	1

Now, you are to analyze the data.

	a) Calculate the necessary details. Analyze the data to identify the problems that may exist in the process. Discuss if the behavior of the reactor is what you have expected. List all the possible assumptions that you may have made.	**20**	**CO2**
	b) Calculate the real conversion that you may expect from the fabricated reactor. You may choose your model with proper justification. Explain in detail the outcome of your calculation.	**15**	**CO4**

The MS-Excel sheet must be uploaded on the LMS portal marked END SEMSTER EXAMINATION, with the following file name Roll number_End sem.