

Name:

Enrolment No:



UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End semester Examination, Dec 2023

Programme Name: B. Tech. (Biotech)

Semester : V

Course Name : Bioreactor Design and analysis

Time : 3 hrs

Course Code : HSBT3002

Max. Marks : 100

Nos. of page(s) : 02

Instructions : Assume any missing data. Draw the diagrams, wherever necessary.

SECTION-A (20 Q× 1.5M = 30 marks)

(Answer all the questions)

		Marks	CO
1	What is the chemical reaction rate?	1.5	CO1
2	What are different types of ideal reactors?	1.5	CO1
3	What is order of the reaction?	1.5	CO1
4	What is molecularity of the reaction?	1.5	CO1
5	What is the general unit of rate of reaction?	1.5	CO1
6	What is the unit of reaction rate constant for a first order system?	1.5	CO1
7	What is the difference between uni and bimolecular reactions?	1.5	CO1
8	How does catalyst act in enhancing the rates of reactions?	1.5	CO1
9	What are other parameters that control conversion which does not go to completion?	1.5	CO1
10	What is time constant of the reactor?	1.5	CO1
11	What way ideal and real reactor differ?	1.5	CO1
12	What is the ideal characteristic of a plug flow reactor?	1.5	CO2
13	What are the reasons for non-ideality in CSTR?	1.5	CO2
14	Give an example of homogeneous reaction?	1.5	CO2
15	What is non elementary reaction?	1.5	CO2
16	Is the order of reaction can be a fraction?	1.5	CO2
17	Define space time.	1.5	CO2
18	$2A + B \xrightarrow{K} C$. what is the rate of formation of product C of this elementary reaction?	1.5	CO2
19	For $C_{A0}=10$ mol/lit and $C_A=2$ mol/lit, what is the conversion x?	1.5	CO2
20	Give an example of catalytic reaction?	1.5	CO2

SECTION-B (4 Q× 5M = 20 marks)
(Answer all the questions)

21	Derive performance equation of an ideal plug flow reactor.	5	CO1
22	Derive performance equation of a fed batch reactor with stream B entering and contents of A residing in the reactor.	5	CO1
23	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 $A \rightarrow R, \quad -r_A = kC_A^{1.5}$ and present conversion is 70%.	5	CO2
24	Brief the importance of mass transfer in the bioreactor and processing of broths.	5	CO3

SECTION-C (2 Q× 10M = 20 marks)
(Answer all the questions)

25	An aqueous feed containing A (1 mol/liter) enters a 2-liter plug flow reactor and reacts away ($2A \rightarrow R, \quad -r_A = 0.05 C^2$ mol/liter s). (a) Write the performance equation of PFR. (b) Find the outlet concentration of A for a feed rate of 0.5 liter/min.	10	CO2
26	Explain the importance of instrumentation and control of a biological process with (a) appropriate flow sheet (b) Use the control diagram to explain the process control.	10	CO3

SECTION-D (2 Q× 15M = 30 marks)
(Answer all the questions)

27	(a) A first order liquid phase reaction $A \rightarrow P$ is conducted in a PFR of volume 5 Lts. The volumetric flow rate is 1 Lt/min with an initial concentration of A as 5 mol/Lt. Find the exit concentration of A if the rate constant is 0.46 /min. (b) In a batch reactor the reaction $A \rightarrow P$ occurs. The conversion of A after 2 minutes is 67% and after 20 minutes is 80%. Find the order of the reaction.	15	CO2
28	(a) Discuss about the factors that lead to the non-ideality in reactors. (b) Discuss RTD, State of aggregation and earliness and lateness of mixing in the non-ideal behavior of a reactor with suitable diagrams and explanations.	15	CO3