U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

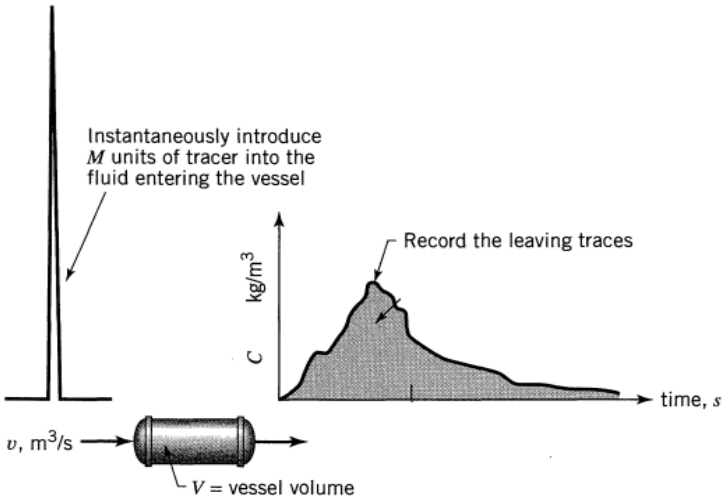
July 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 22BT5PCREN **Max Marks: 100**
Course: Reaction Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

				CO	PO	Marks
			UNIT - I			
1	a)		The rate of reaction at 40°C is three times the rate at 20°C. Determine the activation energy of reaction.	CO2	PO1	**04**
	b)		Derive the integral form of rate equation for irreversible bimolecular type, second order reaction. Represent the rate equation in the form of linear plot by marking slope and intercept.	CO2	PO1	**10**
	c)		Distinguish between order and molecularity with suitable example.	CO2	PO1	**06**
			UNIT - II			
2	a)		Derive the performance equation of steady state plug flow reactor by considering suitable assumptions. Draw the characteristic curves of MFR representing the effect of concentration/conversion on rate of reaction.	CO2	PO1	**10**
	b)		In an isothermal batch reactor 70% of a reactant A is converted in 13 minutes. Find the space time and space velocity to effect this conversion in plug flow reactor and mixed flow reactor.	CO3	PO2	**10**
			OR			
3	a)		Derive the performance equation of recycle reactor with recycle ratio R. Show that reactor approaches plug flow when R is zero and reactor approaches mixed flow when R is infinity.	CO2	PO1	**10**
	b)		The laboratory measurements of rate v/s conversion for reactant A are given below. Compare the volume of CSTR and PFR required to achieve 60% conversion. The feed conditions is same in both conditions and molar flow rate of A is given as 10 mol/s.	CO3	PO2	**10**

X_A	0	0.2	0.4	0.6	0.8
$-r_A$, mol/Ls	0.182	0.143	0.10	0.0667	0.0357

			UNIT – III			
	4	a)	Identify the type of experiment used to find the exit age distribution in the non- ideal reactor.  Determine the equation for area under the curve and mean residence time. Give the characteristics of tracer used in the RTD experiments.	***CO2***	***PO1***	**10**
		b)	A sample of the tracer at 320K was injected as a pulse to a reactor and the effluent concentration measured as a function of time, resulting in the following data: t (min) 0 1 2 3 4 5 6 7 8 9 10 C (g/m³) 0 1 5 8 10 8 6 4 3 2.2 1.5 The measurements represent the exact concentrations at the times listed and not average values between the various sampling tests. 1. Construct figures showing C(t) and E(t) as function of time. 2. Determine both the fraction of material leaving the reactor that has spent between 3 and 6 min in the reactor and 3 min or less.	***CO3***	***PO2***	**10**
			UNIT - IV			
	5	a)	Explain the phases of microbial cell growth with neat diagram.	***CO2***	***PO1***	**08**
		b)	Derive the equation to determine the dilution rate, cell mass concentration and substrate concentration with endogenous metabolism and without endogenous metabolism for cell growth in ideal chemostat.	***CO2***	***PO1***	**12**

			UNIT - V			
	6	a)	Draw fluidized bed bioreactor and explain its working principle. Give advantages and disadvantages.	***CO2***	***PO1***	**10**
		b)	Describe the various strategies needed for stability and analysis of the bioreactors.	***CO2***	***PO1***	**10**
			OR			
	7	a)	Differentiate between scale-up and scale-down bioreactors. Explain both of them with suitable applications.	***CO2***	***PO1***	**04**
		b)	Explain the working principle of air lift bioreactors with a neat diagram. State its advantages and disadvantages.	***CO2***	***PO1***	**10**
		c)	How the bioreactor can be scaled up for fermentation process based on oxygen mass transfer rate? Explain.	***CO2***	***PO1***	**06**

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