U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Biotechnology **Duration: 3 hrs.**
Course Code: 19BT5DCREN **Max Marks: 100**
Course: Reaction Engineering **Date: 21.02.2023**

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

UNIT - I

1 a) Compare and contrast elementary and nonelementary reactions. **04**

b) Describe temperature dependency of rate constant by transition state theory. **06**

c) A decomposition reaction at 313K is 3 times faster compared to 293K. Estimate activation energy for this decomposition. **04**

d) Derive an integrated rate expression for first order reaction for constant volume system with respect to concentration and fractional conversion. **06**

UNIT - II

2 a) Derive performance equation for recycle reactor with the suitable assumptions. **10**

b) Enzyme E catalyses the fermentation of reactant A to product S. Estimate the size of mixed flow reactor required for 95% conversion of reactant A in a feed stream of 25 L/min of reactant A with C_{A0}= 2 moles A/L. The kinetics of the fermentation is given by A → S.
$-r_A=0.10C_A/(1+0.5C_A)$ **10**

OR

3 a) Derive the performance equation for plug flow reactor in terms of concentration and conversion. **10**

b) A high molecular weight hydrocarbon gas A is fed continuously to a heated high temperature mixed flow reactor where it is thermally cracked into lower molecular weight materials collectively called R, by the stoichiometry approximated by A→5R. By changing the feed rate different extents of cracking are obtained as follows: **10**

F_{A0} mmol/h	300	1000	3000	5000
C_{Aout} mmol/L	16	30	50	60

The volume of the reactor is V = 0.1 L and C_{A0} = 100 mmol/L. Find the rate equation to represent the cracking reaction.

UNIT - III

4 a) Stating all assumptions derive the equation for dispersion model in a tubular reactor. **06**

b) From the data given below determine i) the nature of input ii) mean residence time in the vessel iii) E values **10**

T (min)	0	5	10	15	20	25	30	35
C,tracer output conc.(mol/L)	0	3	5	5	4	2	1	0

c) List the characteristics of tracer used in experiments to determine non - ideality in flow. **04**

UNIT - IV

5 a) 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. **10**

b) Experimental data from a batch fermentation off an anaerobic bacterium growing on methanol as a substrate hey is given in the following table. **10**

Time (Hours)	X (g/L)	S (g/L)
0	0.4	18.5
2	0.422	18.4
4	0.61	18.1
8	1.96	16.1
10	3.54	13.6
12	6.4	9.2
14	11.2	1.84
16	12.3	0.154
18	12.4	0

Determine the following

i) Net specific growth rate
ii) Yield of biomass with respect to substrate
iii) Mass doubling time mass

UNIT - V

6 a) With a neat figure illustrate the construction and working principle of airlift bioreactor. State its advantages. **08**

b) Describe the working principle of fluidised bed bioreactors with a neat labelled sketch. **08**

c) Draw and label the typical growth rate curve of a bacterial population. **04**

OR

7 a) Describe the various conditions needed to be adapted for stability of bioreactors. **10**

b) Discuss on the scaleup criteria of the bioreactors how does the dimensional analysis helps in the scaleup of bioreactors? **10**

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