Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL (A constituent unit of MAHE, Manipal)

V SEMESTER B.TECH (BIOTECHNOLOGY)

END SEMESTER EXAMINATIONS, DECEMBER 2021 (REGULAR)

SUBJECT: BIOREACTION ENGINEERING (BIO 3153)

REVISED CREDIT SYSTEM

Time: 75 minutes

(30/12/2021)

MAX. MARKS: 20

Instructions to Candidates:

✤ Answer ALL the questions.

✤ Missing data may be suitable assumed.

			CO	Blooms
Q.No	Question	Marks	Mapped	Taxonomy
				Level
1A.	Hydrolysis of sucrose is carried out in an immobilized invertase enzyme packed bed bioreactor system in series that behaves like a PFR. The multiple reactor system consists of a number of Perspex columns with each 5cm diameter and Length=75 cm in series. The substrate sucrose (S ₀ =4M) is pumped at 0.1 L/min at entrance of the reactor system. The enzyme catalyzed reaction follows the substrate inhibition kinetics. Find the volume of the reactor to achieve 60% conversion at steady state. Also find the number of tubes required to achieve this conversion with above specifications. Substrate inhibition kinetics: $-rs = \frac{Vm.S}{(Km+S+\frac{S^2}{KI})}$ moles/liter.min Kinetics data: Vm=0.028 M/min, Km=0.23 M, KI=0.2 M	4	3	3
2B.	The secondary metabolites (P and Q) are produced using <i>Bacillus</i> species in submerged fermentation process. The following mechanism has been proposed. A \Leftrightarrow P + Q* Q* \rightarrow R* +S R*+Q* \rightarrow 2P A is a substrate, P and S are metabolic products and R*& Q* are intermediates. Prove that above proposed mechanism is consistent with and can explain the observed first order decomposition of substrate A.	4	1	3

2C	When do you prefer recycle reactor-Explain.	2	4	3
2A.	The following data is obtained during RTD study in an non-idea bioreactor. Find: 1. Generate the data for θ and E(θ) and plot 2. Find the fraction of material younger than 40 min. $\boxed{\frac{\text{Time, min}}{\text{Tracer}} 0 2 4 6 7 5 4 3 0}_{\frac{1}{2} 0 \frac{10}{2} 2 4 6 \frac{10}{2} 5 \frac{10}{2} $	 4 	5	4
2B	Hydrolysis of sucrose is carried out in a recycle reactor with free invertase enzyme. The substrate sucrose (S0=10M) is pumped a 0.1 L/h. The recycle ratio R=2.The enzyme catalyzed reaction follows the Michelis-Menten kinetics. Find the volume of the reactor to achieve 60% conversion at steady state. Reaction rate=-rs=0.1S/(0.5+S), M/h	e t } 3	3	3
2C.	A particular biochemical product is produced using a bacillu species in a cascade reactor system of MFR + PFR as shown in the fig 1. The substrate concentration at 1 M, vo=10 lit/min is pumped into the MFR of volume 10 liters. Then the reaction mixture is sent through the PFR of 5 liters capacity. Reaction system: $A \rightarrow R$, follows the 2 nd order kinetics with K=1 liter/gmole.min. Find the conversion of the substrate at the exit of cascade reactor systems. V0=10lit/min, CA0=1M V0=10lit/min, CA0=1M MFR V=10L V=10L FFR V=10L V=1	3	4	3