Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3170407   Date:12-12-2023
Subject Name: Biochemical Engineering
Time: 10:30 AM TO 01:00 PM   Total Marks:70
Instructions:
1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

			Marks
Q.1	(a)	What is the meaning of degree of reduction?	03
	(b)	Change in enthalpy can occur due to which reasons.	04
	(c)	Differentiate between steady state and equilibrium with example.	07
Q.2	(a)	What is the formula and significance of Reynolds number?	03
	(b)	Explain why enthalpy is a state function? Give other examples of state functions.	04
	(c)	Fermentation slurry containing Streptomyces kanamyceticus cells is filtered using a continuous rotary vacuum filter. 120 kg h^{-1} slurry is fed to the filter; 1 kg slurry contains 60 g cell solids. To improve filtration rates, particles of diatomaceous-earth filter aid are added at a rate of 10 kg h^{-1}. The concentration of kanamycin in the slurry is 0.05% by weight. Liquid filtrate is collected at a rate of 112 kg h-1; the concentration of kanamycin in the filtrate is 0.045% (w/w). Filter cake containing cells and filter aid is continuously removed from the filter cloth. (a) What percentage liquid is the filter cake? (b) If the concentration of kanamycin in the filter-cake liquid is the same as in the filtrate, how much kanamycin is absorbed per kg filter aid?	07

OR

	(c)	Water at 25^{0}enters an open heating tank at a rate of 10 kg h^{-1}. Liquid water leaves the tank at 88^{0} at a rate of 9 kg h^{-1}; 1 kg h^{-1} water vapour is lost from the system through evaporation. At steady state, what is the rate of heat input to the system?	07
Q.3	(a)	What happens when contact is broken between a fluid and a solid immersed in the flow path?	03
	(b)	Compare flow curves of various non Newtonian fluids.	04
	(c)	What are various methods for Viscosity Measurement?	07

OR

Q.3	(a)	What do you mean by time dependent viscosity?	03
	(b)	Explain Effect of morphology on broth rheology.	04
	(c)	A fermentation broth with viscosity 10^{-2} Pa s and density 1000 kg m^{-3} is agitated in a 2.7 m^{3} baffled tank using a Rushton turbine with diameter 0.5 m and stirrer speed 1 s^{-1}. Estimate the mixing time.	07
Q.4	(a)	Draw packed bed reactor and trickle-bed reactor with denotation.	03
	(b)	Discuss role of diffusion in bioprocessing.	04
	(c)	Explain the mechanism of transfer of oxygen from gas bubble to the cell in the fermentation.	07

Q.4 **(a)** Draw a chart explaining contributors to total production cost in bioprocess. **03**

(b) Derive formula for Gas-Liquid mass transfer. **04**

(c) A 20-1 stirred fermenter containing a Bacillus thuringiensis culture at 30^0 is used for production of microbial insecticide, kLa is determined using the dynamic method. Air flow is shut off for a few minutes and the dissolved-oxygen level drops; the air supply is then re-connected. When steady state is established, the dissolved-oxygen tension is 78% air saturation. The following results are obtained. **07**

Time (s)	5	15
Oxygen tension (% air saturation)	50	66

a) Estimate kLa. (b) An error is made determining the steady-state oxygen level which, instead of 78%, is taken as 70%. What is the percentage error in kLa resulting from this 10% error in CAL?

Q.5 **(a)** What will be the effect of temperature on reaction rate? **03**
(b) Discuss operating principle of biosensor. **04**
(c) Discuss of kinetics of enzyme deactivation. **07**

OR

Q.5 **(a)** Write equation for Michaelis Menten for enzyme kinetics and Eadie Hofstee plot. **03**
(b) Discuss mechanism of dispersion. **04**
(c) Discuss batch growth using diagram of batch growth curve. Derive formula for specific growth rate. **07**