

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VII(NEW) • EXAMINATION – WINTER 2016

Subject Code:2170407**Date:23/11/2016****Subject Name:Biochemical Engineering-I****Time:10.30 AM to 1.00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Derive suitable equation for kinetics of enzyme deactivation. **07**
(b) Write a note on: Role of shear in stirred fermentor. **07**

- Q.2** (a) Discuss the mechanisms of mixing. **07**
(b) Write a note on: Transport phenomena for bioprocesses. **07**

OR

- (b) Derive and discuss Michaelis-Menten kinetics. **07**
- Q.3** (a) *Acetobacter aceti* bacteria convert ethanol to acetic acid under aerobic conditions. A continuous fermentation process for vinegar production is proposed using non-viable *A. aceti* cells immobilized on the surface of gelatin beads. The production target is 2 kg h⁻¹ acetic acid; however the maximum acetic acid concentration tolerated by the cells is 12%. Air is pumped into the fermenter at a rate of 200 hmol h⁻¹. **07**
(a) What minimum amount of ethanol is required?
(b) What minimum amount of water must be used to dilute the ethanol to avoid acid inhibition?
(c) What is the composition of the fermenter off-gas?

- (b) Give the relations between shear stress and strain for Newtonian and Non-Newtonian fluids. Enlist examples of each. **07**

OR

- Q.3** (a) The chemical reaction equation for respiration of glucose is: **07**
$$\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \longrightarrow 6 \text{CO}_2 + 6\text{H}_2\text{O}.$$

Candida utilis cells convert glucose to CO₂ and H₂O during growth. The cell composition is CH_{1.84}O_{0.55}N_{0.2} plus 5% ash. Yield of biomass from substrate is 0.5 g g⁻¹. Ammonia is used as nitrogen source.

[1] What is the oxygen demand with growth compared to that without?

[2] *C. utilis* is also able to grow with ethanol as substrate, producing cells of the same composition as above. On a mass basis, how does the maximum possible biomass yield from ethanol compare with the maximum possible yield from glucose?

- (b) Differentiate between: Bioprocess engineering, Biochemical Engineering and Bioengineering. **07**

- Q.4** (a) A 20-litre fermenter containing *Bacillus thuringiensis* culture at 30 °C is used for production of microbial insecticide. K_La is to be determined. Air flow is **07**

shut off for few minutes and DO level drops the air supply is then reconnected. When steady state is established, the DO tension is 78% air saturation. The following results are obtained.

	T ₁	T ₂
Time	5	15
Oxygen tension	50	66

Where C_{AL} = final steady DO concentration and C_{AL} = DO Concentration

- a) Estimate K_{La} .
- b) An error is made determining steady state oxygen level, which instead of 78% is taken as 70%, what is the percentage error in K_{La} resulting from this 10% error in C_{AL} .

(b) Suggest the ways to improve mixing in fermenter. **07**

OR

Q.4 (a) Narrate first order kinetics with suitable equations. **07**

(b) Write a note on: Diffusion theory **07**

Q.5 (a) With a neat sketch, explain Chemostate operation. Comment on its kinetics. **07**

(b) Derive the formula for total time for a batch reaction cycle **07**

OR

Q.5 (a) Compare and Contrast: Bubble column and Air-lift bioreactor. **07**

(b) Write a note on: Filter sterilization of liquids. **07**
