

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2170407

Date: 26/11/2018

Subject Name: Biochemical Engineering-I

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.

- | | | MARKS |
|------------|---|-----------|
| Q.1 | (a) Define the terms: Respiratory quotient, Yield, Growth rate limiting reaction. | 03 |
| | (b) Discuss the sterilization of air for the fermentation operation. | 04 |
| | (c) A fermenter containing microbial culture at 30 °C is used for production of microbial insecticide with its 20-litre capacity. K_{La} is to be determined. Air flow is shut off for few minutes and DO level drops the air supply is then reconnected. When steady state is established, the DO tension is 77% air saturation. | 07 |

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 77% is taken as 69%, what

- | | | |
|------------|--|-----------|
| Q.2 | (a) How do the analogy exists between mass and heat transfer? | 03 |
| | (b) Discuss the basic steps for designing of a bioreactor. | 04 |
| | (c) The fungus <i>Aureobasidium pullulans</i> is used to produce extracellular polysaccharides by fermentation of sucrose. After 120h fermentation, the following measurements of shear stress and shear rate were made with a rotating cylinder viscometer. | 07 |

| Shear Stress dyn cm^{-2} | Shear Rate s^{-1} |
|-----------------------------------|----------------------------|
| 44.1 | 10.2 |
| 235.3 | 170 |
| 357.1 | 340 |
| 457.1 | 510 |
| 636.8 | 1020 |

- [1] Plot the rheogram for this fluid.
- [2] Determine the appropriate Non Newtonian parameters.
- [3] find the apparent viscosity at the shear rates of ; 15 s^{-1} and 200 s^{-1} .

OR

- | | |
|---|-----------|
| (c) A bacterium converts ethanol to acetic acid under aerobic conditions. A continuous fermentation process for vinegar production is proposed using non-viable bacterial cells immobilized on the surface of gelatin beads. The production target is 2 kg h^{-1} acetic acid; however the maximum acetic acid | 07 |
|---|-----------|

concentration tolerated by the cells is 12%. Air is pumped into the fermenter at a rate of 200 mmol h⁻¹.

- (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?

- Q.3**
- (a) Derive the equations for Eddie-Hofstee plot and Lineweaver –Burke plot. **03**
 - (b) Enlist the energy concerns from heat transfer point of view for a bioreactor. **04**
 - (c) Write about Non- Newtonian fluids with suitable equations. Explain each of them for its stress and strain relation analogous to the law of viscosity. **07**

OR

- Q.3**
- (a) Discuss the dynamic method to determine $K_L a$. **03**
 - (b) Enlist the enzymes which are medical importance. **04**
 - (c) Discuss the practical considerations for bioreactor constructions. **07**
- Q.4**
- (a) Write a note on: Orifice and Nozzle spargers **03**
 - (b) Discuss aseptic operation by giving schematic to show operating procedures. **04**
 - (c) Explain the concept of air lift bioreactor. Compare it with fluidized bed bioreactor. **07**

OR

- Q.4**
- (a) What is the importance of modeling? Where and how does it help in fermentation plants? **03**
 - (b) Explain the measurement of DO concentrations. **04**
 - (c) Justify the statement: “Chemostate culture evaluates the kinetic and yield parameters.” **07**
- Q.5**
- (a) Derive equation to narrate death kinetics of cell culture. **03**
 - (b) How cells grow? Which factors affect? **04**
 - (c) Define bioprocess engineering. Explain the role of biotechnology in that. **07**

OR

- Q.5**
- (a) What are the effects of conditions on Enzyme reaction rate? **03**
 - (b) Write a note on: Assessing mixing effectiveness **04**
 - (c) Write the transfer of oxygen from gas bubbles to cell. **07**
