

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-VII EXAMINATION – WINTER 2015**

**Subject Code: 170404****Date: 16/12/2015****Subject Name: Bioprocess Engineering -1****Time: 10:30am to 1:00pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Notations used have conventional meaning.

- Q.1** (a) Write a note on scale up and scale down and factors affecting it. **07**  
 (b) Explain the types of fluids. Give the relation of stress and strain for each of them with examples. **07**
- Q.2** (a) Enlist and explain the criteria to design fermentation systems. **07**  
 (b) 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 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. **07**

	T <sub>1</sub>	T <sub>2</sub>
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  $C_{AL}$ .
- OR**
- (b)** A Strain of Azotobacter is Cultured in a 15m<sup>3</sup> Stirred Fermentor for alginate production under current operating condition.  $K_{La}$  is 0.17 1/S . Oxygen solubility in the broth is approx 8x10<sup>-3</sup>kg/m<sup>3</sup> **07**
- (a) Specific rate of oxygen uptake is 12.5 mmol g<sup>-1</sup> h<sup>-1</sup>. What is maximum possible cell concentration?
  - (b) The bacteria suffer growth inhibition after copper sulphate is accidentally added to fermentation broth. This causes a red in oxygen uptake rate to 3mmol g<sup>-1</sup>h<sup>-1</sup>. What maximum cell concentration now be supported by the fermentation?
- Q.3** (a) Explain the functions of each of these types of fermentation vessels: The Waldhof type fermenter, Tower fermenter, Cylindro conical vessels. **07**  
 (b) How will you handle the animal cell culture in a bioreactor? **07**

**OR**

- Q.3** (a) Compare air lift bioreactor with bubble column bioreactors. **07**  
 (b) What are the ways by which substrates get consumed? Explain briefly. Define Respiratory Quotient and give its importance. **07**
- Q.4** (a) Discuss the role of diffusion, distribution and dispersion in mass transfer of oxygen in fermenter. **07**  
 (b) Anaerobic fermentations typically produce a variety of partially oxygenated compounds in addition to cell mass. If the cell molecular formula is given by  $C_6H_{10}O_3N$ , Calculate the unknown coefficients for the following typical equation where coefficients are given as mole quantities and not in mass.  

$$5.56 \text{ (Glucose)} + A(NH_3) \rightarrow B \text{ (cell mass)} + C(\text{Butanol}) + D(\text{Succinic acid}) + 2.20 \text{ (glycerol)} + 3.40 \text{ (H}_2\text{O)} + 3.75 \text{ CO}_2 + 1.08 \text{ (ethanol)}$$

**OR**

- Q.4** (a) Enlist physical methods of control of microorganisms. **07**  
 (b) Differentiate between Chemical Reaction and Biochemical Reactions. **07**
- Q.5** (a) Briefly explain Interaction between cells and turbulent eddies and Discuss on damage caused by shear. **07**  
 (b) What is the role of P,I, and D controllers in achieving set point of fermentor? How does it help in controlling the operations of fermentor? **07**

**OR**

- Q.5** (a) Discuss about genetic algorithm and compare it with ANN. **07**  
 (b) Give the meaning of the terms Structured model and unstructured model, black box model. **07**

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