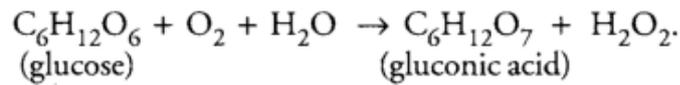


**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-VII (NEW) EXAMINATION – SUMMER 2024****Subject Code: 3170407****Date: 24-05-2024****Subject Name: Biochemical Engineering****Time: 02:30 PM TO 05:00 PM****Total Marks:70****Instructions:**

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.

|  | <b>Marks</b> |
|--|--------------|
| <b>Q.1 (a)</b> What is role of bioprocess engineer in an industry?   | <b>03</b>    |
| <b>(b)</b> What is working machinery of a cell? Explain different functions of it in efficient working of cell.  | <b>04</b>    |
| <b>(c)</b> Xanthan gum is produced using <i>Xanthomonas campestris</i> in batch culture. Laboratory experiments have shown that for each gram of glucose utilised by the bacteria, 0.23 g oxygen and 0.01 g ammonia are consumed, while 0.75 g gum, 0.09 g cells, 0.27 g gaseous CO <sub>2</sub> and 0.13 g H <sub>2</sub> O are formed. Other components of the system such as phosphate can be neglected. Medium containing glucose and ammonia dissolved in 20000 litres water is pumped into a stirred fermenter and inoculated with <i>X. campestris</i> . Air is sparged into the fermenter; the total amount of off-gas recovered during the entire batch culture is 1250 kg. Because of the high viscosity and difficulty in handling xanthan-gum solutions, the final gum concentration should not be allowed to exceed 3.5 wt%.<br>(a) How much glucose and ammonia are required?<br>(b) What percentage excess air is provided? | <b>07</b>    |
| <b>Q.2 (a)</b> Define the terms latent heat of vaporization, latent heat of fusion and latent heat of sublimation.   | <b>03</b>    |
| <b>(b)</b> Classify the liquids based on its viscosity.  | <b>04</b>    |
| <b>(c)</b> How does baffles aids in effective mixing? Explain different arrangements of baffles in reactor.  | <b>07</b>    |
| <b>OR</b>  |              |
| <b>(c)</b> Explain fluid flow pattern generated by radial and axial flow impellers.  | <b>07</b>    |
| <b>Q.3 (a)</b> What is balanced growth?  | <b>03</b>    |
| <b>(b)</b> Explain Lineweaver Burk and Eadie Hofstee Plot.   | <b>04</b>    |
| <b>(c)</b> Explain steps for mass transfer of oxygen from gas bubble to interior of cell.  | <b>07</b>    |
| <b>OR</b>  |              |
| <b>Q.3 (a)</b> Explain Theoretical and Observed yields.  | <b>03</b>    |
| <b>(b)</b> Explain Michaelis-Menten Kinetics.  | <b>04</b>    |
| <b>(c)</b> Explain Dynamic method for K <sub>La</sub> measurement.   | <b>07</b>    |
| <b>Q.4 (a)</b> How is patterned flow achieved in an airlift loop reactor?  | <b>03</b>    |
| <b>(b)</b> Derive the equation for a batch time in a well-mixed fermenter for a cell culture.  | <b>04</b>    |

- (c) The enzyme, glucose oxidase, is used commercially to remove glucose from dehydrated egg to improve colour, flavour and shelf-life. The reaction is: **07**



A continuous-flow reactor is set up using immobilised-enzyme beads which are retained inside the vessel. Dehydrated egg slurry containing 2% glucose, 20% water and the remainder unreactive egg solids, is available at a rate of 3000 kg h<sup>-1</sup>. Air is pumped through the reactor contents so that 18 kg oxygen are delivered per hour. The desired glucose level in the dehydrated egg product leaving the enzyme reactor is 0.2%.

Determine:

- (a) which is the limiting substrate;
- (b) the percentage excess substrate;
- (c) the composition of the reactor off-gas; and
- (d) the composition of the final egg product.

**OR**

- Q.4** (a) Explain different designs of sparger. **03**  
(b) Explain temperature time profile for a batch sterilization cycle. **04**  
(c) Explain cone and plate viscometer with diagram. **07**

- Q.5** (a) Explain application of unstructured models. **03**  
(b) Explain various components of a biosensor. **04**  
(c) Explain kinetics of substrate uptake in presence and absence of product formation. **07**

**OR**

- Q.5** (a) Explain the terms distribution, diffusion, and dispersion. **03**  
(b) Explain Boundary Layer separation. **04**  
(c) Explain film theory. **07**

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