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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- December-2018

B.Tech 5<sup>th</sup> Semester

COURSE CODE: 15B11BT511

MAX. MARKS: 35

COURSE NAME: Bioprocess Engineering

COURSE CREDITS: 04

MAX. TIME: 02 Hours

*Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

1. Define the following terms and its significance: [CO 1] [2]
  - a) Kolmogorov Scale
  - b) Saturation Constant ( $K_s$ )
2. Which bioreactor is better in mass and heat transfer efficiency and why? [CO2] [3]
  - a) Airlift and Bubble column Bioreactor
  - b) Airlift bioreactor with internal loop and with external loop
  - c) Fixed Bed and Fluidized Bed Bioreactor

[CO3]
3.
  - a) Why a chemostat cannot run at a dilution rate greater than the specific growth rate? [1]
  - b) If a culture grows with a specific growth rate of  $0.8 \text{ hr}^{-1}$ , then calculate the doubling time of the culture. [1]
  - c) Differentiate between Growth associated and non-growth associated products. [1]
  - d) If you wish to run a fermenter system at a higher dilution rate greater than the specific growth rate, then which kind of system will you use and why? [2]

[CO4]
4.
  - a) How the oxygen solubility is affected with the salts and temperature? [1]
  - b) What should be the minimum and maximum distance between two impellers in a multi-impeller agitator and why? [2]
  - c) A genetically-engineered strain of yeast is cultured in a bioreactor at  $30^\circ\text{C}$  for production of heterologous protein. The oxygen requirement is  $80 \text{ mmol l}^{-1}\text{h}^{-1}$ ; the critical oxygen concentration is  $0.004 \text{ mM}$ . The solubility of oxygen in the fermentation broth is estimated to be 10% lower than in water due to solute effects. The solubility of oxygen in pure water at  $1 \text{ atm}$

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pressure is  $8.05 \times 10^{-3} \text{ Kg m}^{-3}$ . Calculate the minimum mass-transfer coefficient required to sustain this culture if the reactor is sparged with air at approximately 1 atm pressure? [2]

[CO5]

5. a) How the impeller speed affects the mass transfer efficiency of the system? [1]  
b) Why KOH is preferred over NaOH for controlling the pH in a fermentation process? [1]  
c) Determine the dead band value of pH in a fermenter system if you wish to run it at set value of 6.0. Here the dead band should lie in the range of 6% of the set value. [2]  
d) Draw the self explanatory sketch diagrams of various designs of Airlift Bioreactor. [1.5]  
e) List the major functions of the following: [4.5]  
i) Agitator                      ii) Baffles                      iii) Head Space Volume

[CO6]

6. a) What is scale down? How it is important? [2]  
b) Define Scale up and its importance. [2]
8. Consider the scale-up of a fermentation from a 10 l to 10,000 l vessel. The small fermenter has a height-to-diameter ratio of 3. The impeller diameter is 30% of the tank diameter. Agitator speed is 500 rpm and three Rushton impellers are used. Determine the dimensions of the large fermenter and agitator speed for:  
a) Constant  $P/V$  [2]  
b) Constant impeller tip speed [2]  
c) Constant Reynolds Number [2]

JUIT 13 EXAMINATION DEC 2018