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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2021

B.Tech V Semester

COURSE CODE: 18B11BT511 MAX. MARKS: 35

COURSE NAME: Bioprocess Engineering

COURSE CREDITS: 04 MAX. TIME: 2 Hours

***Note:** All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. For calculations, you may use simple/scientific calculator.*

1. **a)** Determine the doubling time of a bacterial culture if it has specific growth rate 0.6 hr^{-1}. [CO3] **[1]**

b) Why the chemostat in series is better than using a single chemostat fermenter for the production of recombinant products? [CO3] **[2]**

2. If a medium and the product formed generates more foam, so how will you deal with such conditions while running a fermenter? [CO2] **[2]**

3. Determine the dead band value of pH in a fermenter system if you wish to run it at set value of 7.0. Here the dead band should lie in the range of 8% of the set value. [CO5] **[2]**

4. For an aerobic culture which bioreactor will you use: Fermenter A which has K_La value = 0.2 sec^{-1} or Fermenter B having K_La value = 0.4 sec^{-1}? Give a proper justification of your selection. [CO2, CO4] **[2]**

5. An industrial fermentor containing 10,000 L of medium needs to be sterilized. The initial spore concentration in the medium is 10^6 spores mL^{-1}. The desired probability of contamination after sterilization is 10^{-3}. The death rate of spores at 121 °C is 4 min^{-1}. Assume that there is no cell death during heating and cooling phases. Determine the holding time of the sterilization process in min. [CO3, CO4] **[2]**

6. List the 3 independent and 3 dependent variables with their units. [CO1] **[3]**

P.T.O.

7. Which bioreactor is more efficient in mass and heat transfer from the following: Justify your answer with the appropriate reasons and diagram. [CO5] **[4]**

   a) Airlift bioreactor and bubble column

   b) Fixed Bed Bioreactor and Fluidized bed Bioreactor

8. Differentiate between (At least 3 main differences) [CO1, CO5] **[6]**

   a) Static and Dynamic Gassing out method

   b) Airlift bioreactor with internal loop and with external loop

9. A genetically-engineered strain of bacteria is cultured in a bioreactor at 35^0C for production of a heterologous protein. The oxygen requirement is 80 mmol $l^{-1}h^{-1}$; the critical oxygen concentration is 0.004 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 atm pressure is 8.05 x 10^{-3} 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? [CO4] **[4]**

10. **a)** If the height-to-diameter ratio remains constant, then what happened to the surface-to-volume ratio during scaling up? How will it affect the bioprocess during scaling up? **[2]**

    b) A stirred-tank reactor is to be scaled down from 10 m^3 to 0.1 m^3. The dimensions of the large tank are: Dt = 2 m; Di = 0.5 m; N = 100 rpm. Determine the dimensions of the small tank (Dt, Di, H) by using geometric similarity. [CO6] **[3]**

    c) For the above question, what would be the required rotational speed of the impeller in the small tank if we use Constant tip speed as the scale down criteria? [CO6] **[2]**