JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2021

B.Tech V Semester (Backlog)

COURSE CODE: 15B11BT511   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 0.9 hr^{-1}. [CO3]
   [1]

   b) If a culture has a residence time of 12 h in a chemostat, what will be the dilution rate? [CO3]
   [2]

2. Determine the dead band value of 5% if the pH set value of a fermenter is 8.0. [CO5] **[2]**

3. 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]**

4. 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 5 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]**

5. What are advantages and disadvantages of immobilization of cells? [CO1] **[3]**

6. List the major functions of the following in a fermenter: [CO5] **[4]**

   i) Agitator   **ii)** Baffles

7. Differentiate between (At least 3 main differences) [CO1, CO5] **[9]**

   a) Radial flow and Axial flow Impellers

   b) Fixed and fluidized Bed Bioreactor

   c) Growth associate and Non-growth associated products

8. A fermentation broth with viscosity 10^{-2} Pa s and density 1000 kg m^{-3} is agitated in a 2.7 m^3 baffled tank using a Rushton turbine with diameter 0.5 m and stirrer speed 1 s^{-1}. Estimate the mixing time. [CO4] [3]

9. a) If the height-to-diameter ratio remains constant, then what happened to the surface-to-volume ratio during scaling down? [CO6] [2]

   b) 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 Constant P/V. [CO6] [3+2]