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Question Paper Code: U4D06

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2024

Fourth Semester

Biotechnology

21UBT402- BIOPROCESS PRINCIPLES

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. In an industry, a newly designed reactor is experiencing vortex formation during agitation process. Give a solution to overcome the vortex problem. CO2–App
2. List out the components of fermentation process. CO1 – U
3. Define the role of precursor with example CO1 – U
4. In an aerobic fermentation process, accidentally the oxygen supply was stopped. It was observed that the pH of the medium is approaching to acidic. What could be the reason for the reduction in pH and justify your answer. CO2–App
5. Write the significance of D – Value. CO1 – U
6. In a bioreactor to remove the suspended particles from the compressed air which sterilization can be used? Justify it CO2–App
7. Determine the degrees of reduction of glucose, ethanol, butanol and hexane CO1 – U
8. In an anaerobic fermentation two molecules of CO₂ was produced. Now calculate the respiratory quotient of the experiment. CO2–App
9. Differentiate Batch and Fed-Batch cultivation. CO1 – U
10. Fed-batch cultivation is selected to overcome substrate inhibition”. Justify this statement. CO2–App

PART – B (5 x 16= 80 Marks)

11. (a) Consider a case where *E.Coli* is cultivated to produce protease enzyme. Illustrate with neat sketch about the design of continuous stirred tank reactor for cultivation of *E.Coli*. CO2-App (16)

Or

- (b) Classify important process parameters that need to be monitored and control for optimal production of the selected bioproducts in bioreactor. Choose any four parameters and comment on the design of instruments for monitoring the chosen parameters. CO2-App (16)

12. (a) Enlist the criteria for good medium and discuss about Carbon, Nitrogen and Minerals. CO1-U (16)

Or

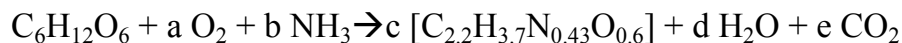
- (b) Explain in detail about the Plackett- Burmann design for determining influencing parameter in the process. CO1- U (16)

13. (a) Derive the design equation to determine depth of the air filter CO2-App (16)

Or

- (b) A steam sterilizer is used to sterilize liquid medium for fermentation. The initial concentration of contaminants is 10^8 per litre. How long 1 m^3 medium be treated if the temperature is 80°C , 121°C , 140°C Assume all the contaminants are *B.st.* $E=283 \text{ KJ/gmol}$; $A=10^{36.2} \text{ sec}^{-1}$ $R = 8.3144 \text{ J/K/gmol}$. CO2- App (16)

14. (a) The carbon substrate was converted to biomass with an efficiency of 34 % w/w by a culture of microbes. Calculate the stoichiometric coefficients for the following biological reaction and also determine the degree of reduction of the substrate molecule and respiratory quotient



Or

- (b) Production of single cell protein from hexadecane is described by the following reaction equation CO3- App (16)



Where, $\text{CH}_{1.66}\text{O}_{0.27}\text{N}_{0.20}$ represents the biomass. If $\text{RQ} = 0.43$,

- Determine the stoichiometric coefficients.
- Determine degree of reduction of the substrate molecule
- Determine the yield coefficient with respect to each of the reactants.

15. (a) A bio-fertilizer industry produces *Azotobacter* in a large scale. CO2–App (16)
They are hiring a bioprocess engineer for monitoring the growth.
Suggest the possible methods that the engineer can monitor the growth and comment on each method.

Or

- (b) Consider yourself as the research team head. Your team is CO2–App (16)
designing a batch cultivation process for culturing prokaryotic microorganism. Suggest an appropriate unstructured model for the growth of the microorganism. Derive the necessary characteristic equations with appropriate design parameter.

