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Question Paper Code: R4C03

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Biotechnology

R21UBT403 – BIOPROCESS PRINCIPLES

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Define fermentation and mention their types. CO1- U
2. What are antifoams? Give examples. CO1- U
3. List out the role of phosphorous, nitrogen, and sulphur in the production medium CO1- U
4. In industries, the classical method of optimization is not always be selected for optimization. Predict the reason and comment on it. CO2-App
5. How will you determine the depth of the filter? CO1- U
6. The initial number of contaminants is 10^{14} and the decimal reduction value at 121°C is 1.5 min. Calculate the time required to bring down the contaminants to industrially acceptable limits. CO2-App
7. Determine the degrees of reduction of glucose, ethanol, butanol and hexane. CO1- U
8. How will you calculate theoretical oxygen demand? CO1- U
9. Differentiate Batch and Fed-Batch cultivation. CO1- U
10. Determine the doubling time of the bacteria which has specific growth rate of 0.2 h^{-1} CO2-App

PART – B (5 x 16= 80 Marks)

11. (a) Discuss in detail about the design criteria, vessel dimensions, agitator types, aspect ratios and other parameters of a microbial fermenter with neat sketch. CO1- U (16)

Or

- (b) Elaborate the role of mixing, mixing pattern and different types of agitators in bioreactor. CO1- U (16)
12. (a) Choose an appropriate technique to screen and interpret the important variables for the production of lipase enzyme. Justify the selection and demonstrate the procedure to be adopted for optimization. CO2 - App (16)
- Or
- (b) In the production of single cell protein, Spirulina, there are 7 variables selected for optimization. It is decided to screen the important variables which influence the biomass production. Select appropriate method to determine the most influencing variables in the production medium and comment on the screening procedure. CO2 - App (16)
13. (a) Describe the process of batch sterilization design with necessary graphs and equations. CO1- U (16)
- Or
- (b) Illustrate the various classification of sterilization technique and explain it in detail. CO1- U (16)
14. (a) Aerobic dehydration of benzoic acid by mixed culture can be represented by following reaction:

$$\text{C}_6\text{H}_5\text{COOH} + a \text{O}_2 + b \text{NH}_3 \rightarrow c \text{C}_5\text{H}_7\text{NO}_2 + d \text{H}_2\text{O} + e \text{CO}_2$$
 After the reaction the reaction gives respiratory quotient of 0.7.
 - Determine the stoichiometry coefficients
 - Determine degree of reduction of the substrate molecule
 - Determine the yield coefficient with respect to each of the reactants
 CO3- App (16)
- Or
- (b) 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

$$\text{C}_6\text{H}_{12}\text{O}_6 + a \text{O}_2 + b \text{NH}_3 \rightarrow c [\text{C}_{2.2}\text{H}_{3.7}\text{N}_{0.43}\text{O}_{0.6}] + d \text{H}_2\text{O} + e \text{CO}_2$$
 CO3- App (16)

15. (a) In the Research and Development department of a company, your team is assigned to design a cultivation strategy to produce secondary metabolite. Choose the appropriate strategy and comment on your selection with necessary block diagram and design equation. CO4- Ana (16)

Or

- (b) Scientists at ICMR are working on laboratory of Metabolic Research. They have identified X and Y as products. They were confused in identifying primary and secondary metabolites among X and Y. As part of Research, they are at the analysis point now. X is produced in large quantities and Y is produced in low quantity. X has shown importance in growth and reproduction while Y has actively involved in defensive action. Identify X and Y, which among X and Y are produced in log phase, Draw the graph of microbial growth curve and various stages in detail. CO4- Ana (16)

