

[illegible]

Total No. of Questions : 08

Paper ID : [E0873]

Max. Marks : 100

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWENTY marks.

- Q1 a) Explain the kinetics of a continuous culture system with relevant mathematical expressions.
- b) A beverage company produces 'Raspberry Syrup' for the delicious cocktail drink. To produce this, ripen raspberries comprising 5% seeds, 20% pulp solids and rest water are initially homogenized in a stainless steel mixing tank where sugar is added so as to achieve a raspberry:sugar mass ratio of 3.5:1. The combined mixture is blended, strained to remove solids, and then heated to reduce the water content to 35%. The productivity of 'raspberry syrup' was calculated to be 500 kg/day.
- i. Make a flow sheet diagram for the above bioprocess with proper labeling.
- ii. What mass of raspberries would be required per week?
- iii. How much sugar is required per week?
- iv. Calculate the sugar content in the 'Raspberry Syrup' (per day).
- Q2 a) What is Del factor? Describe the advantages of continuous sterilization over batch sterilization.
- b) Draw time-temperature profile for various types of continuous sterilizers.
- Q3 a) Explain the importance of aeration and agitation in a bioreactor. Draw a neat sketch of various designs of impellers.
- b) Enlist the routes with which oxygen gets transferred from gas phase to microbial cell. Define volumetric transfer coefficient.

- Q4 a) Describe the important measurement and control parameters while operating a bioreactor.
- b) What is a Proportional Integral Derivative (PID) controller?
- Q5 Explain the basic theory involved in crystallization process. What are the different parameters considered before crystallising a compound for purification of bioproducts?
- Q6 a) Explain in detail working of a disc centrifuge with a neat and labeled diagram. Derive all the relevant expressions.
- b) A protein has a sedimentation coefficient of 7.16 S, a diffusion coefficient $D = 4.45 \times 10^{-7} \text{ cm}^2 \text{ sec}^{-1}$ and $v_p = 0.73 \text{ cm}^3 \text{ g}^{-1}$ (all measured at 20°C). (a) How long will it require to migrate from $r = 10 \text{ cm}$ to $r = 10.1 \text{ cm}$ in a rotor spinning at 50,000 rpm ($5 \times 10^4 \text{ rpm}$)? (Assume constant velocity throughout this time). (b) What is the molecular weight of the protein?
- Q7 a) What are the criteria for selecting the extraction process in a bioprocess industry?
- b) Show that the length of an idealized counter current differential extractor is expressed as
- $$l = \left[\frac{H}{ka} \right] \left\{ \frac{E}{E-1} \ln \left(\frac{y_1 - x_1/K}{y_0} \right) \right\} \text{ Where, } E = KL/H \text{ and } k = \text{rate constant}$$
- Q8 Write short notes on following :
- a) Cross flow filtration.
- b) Methods of cell disruption.