Exam.Code:1032
Sub. Code: 7866

1128

M. E. (Bio-Technology)

First Semester

ME-BIO-104: Bio-Separation and bio-Process Technology

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Section.

x-x-x

1)

i. If one starts with 10,000 cells in a culture that has a generation time of 2 h, how many cells will be in the culture after 4 and 48 h?

ii. Can growth rate of the cell be greater than the dilution rate in CSTR? Explain.

iii. What do you mean by "Quasi steady state"?

iv. What is the yield coefficient if the initial substrate concentration is 10 g/l and biomass is 0.1 g/l. The substrate is then consumed and produces 5.3 g/l of biomass?

v. What is the unit of maintenance coefficient "m"?

vi. Deduce strategies to improve the rate of filtration.

vii. Define concentration factor and partition factor.

viii. What is the difference between salting-in and salting-out?

ix. Define sigma factor and g-number of a centrifuge.

x. Explain the process of diffusion in bioprocessing. (1 each)

SECTION-A

2. A) Summarize in a table form various size range and applications of filtration processes by giving examples.

B)With the help of appropriate expressions deduce relationship between solubility and salt concentration during precipitation procedure.

C) Classify membranes on the basis of membrane structure and subsequent applications. (3,4,3)

3. A)Explain the principle of dialysis using appropriate expressions and diagram.

B)What could have been wrong in the following, discuss. i) The bands were blurry in images of the gel taken after electrophoresis. ii) The loading dye migrated in arc pattern during electrophoresis. (5,5)

4. A) A continuous disc stack centrifuge is operated at 5000 rpm for separation of baker's yeast. At a feed rate of 60 l min^{-1}, 50% of the cells are recovered. For operation at constant centrifuge speed, solids recovery is inversely proportional to the flow rate. What flow rate is required to achieve 90% cell recovery if the centrifuge speed is maintained at a) 5000 rpm b) 60 l min^{-1}?

B)Describe using sketch the working principle of disc-stack bowl centrifuge with continuous discharge of solids. (5,5)

SECTION-B

5. A) In a two stage chemostat system, the volumes of the first and second reactors are V1 = 500 litres and V2 = 300 litres, respectively. The first reactor is used for biomass production and the second is for a secondary metabolite formation. The feed flow rate to the first reactor is F = 100 l/h and the glucose concentration in the feed is S = 5.0 g/l. (i) Determine the cell and glucose concentrations in the first stage. (ii) Assume that growth is negligible in the second stage and the specific rate of product formation is q_p = 0.02 gP/gcell*h, and $Y_{P/S}$ = 0.6 gP/gS. Perform a substrate component balance on the second reactor and determine the product and substrate concentrations in the effluent of the second reactor.

B) Differentiate between structured and unstructured model; segregated and unsegregated model. (6,4)

6. A) Microbial cells are being cultivated in a 50 m^3 batch bioreactor using 6% inoculum. The inoculum has a biomass concentration of 4 g/l at the time of inoculation. Growth follows the Monod kinetics, with μ_{max} = 0.4 h^{-1}; K_s = 0.2 kg/m^3 and the observed yield of biomass based on substrate is 0.5 Kg/Kg. It the time required for media preparation, sterilization and cleaning the fermenter is 12 hours, calculate the highest specific biomass production rate for a feed substrate concentration of 10 kg/m^3.If this industry is to switch over to continuous fermentation, what is the maximum specific biomass production rate achievable? How does this compare with the batch operation?

B) "Generation time of a single cell is actually less than the overall doubling time of the population". Do you agree with this statement? Why? (8,2)

7. A) The bacteria X-II can be described by a simple Monod equation with μmax = 0.8 h^{-1}, K_S = 4 g/dm^3, $Y_{P/X}$ = 0.2 g/g and $Y_{S/X}$ = 2.2 g/g. The process is carried out in a CSTR in which the feed rate is 1000 dm^3/h at a substrate concentration of 10g/dm^3.(i) What size fermentor is needed to achieve 90% conversion of substrate?(ii) What is the exiting cell concentration?(iii) Determine the volumetric flow rate at which wash-out occurs and also the flow rate at which the cell production rate is maximum.

B) Which cultivation conditions (Batch, Fed-batch or continuous) would you use(i) In a product inhibited system and why?(ii) In a substrate inhibited system and why?

C) How is fed batch reactor different from batch and continuous reactors? Also show how μ, V, So, S, X, growth associated and non growth associated product formation varies with time in a fed batch system. (6,2,2)

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