Exam. Code: 0909
Sub. Code: 6309

2063

B.E. (Biotechnology) Fifth Semester

BIO-512: Bio-Process Engineering

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. Attempt the following:-

a) Discuss ways to control critical biomass concentration.

b) Justify the need of scale-down.

c) Define del factor.

d) Define apparent viscosity and its role in bioreactor design?

e) Explain the anlogy between heat and filter sterilization.

f) Define washout.

g) Discuss the role of precursors in a fermentation medium.

h) Obtain an expression for steady-state cell-concentration in a chemostat as a function of dilution factor.

i) Differentiate between defined and complex media.

j) Explain the significance of Q_{O2}. (10)

Section-A

2. A) Give a brief account on metabolite production in a batch culture. Support your answer with suitable plots and/or expressions.

B) Discuss the following in context of fed-batch culture I) Quasi-steady state ii) Cyclic fed-batch iii) applications. (4,6)

3. Enlist major factors involved in scale-up of any fermentation process. Suggest how would you recommend suitable operating boundaries for aeration and agitation using scale-up window. (10)

4. Discuss any two rheologies having a close match with penicillin broth rheology. Also, explain the effect of medium and culture rheology on aeration capacity of the fermenter. (10)

Section-B

5. i) Why foaming should be controlled in fermentation broths? Discuss various methods available for controlling foam.

ii) Describe the criteria for the choice of a bioreactor for immobilized systems. What are the various types of bioreactors suitable? (5,5)

6. A)Deduce the Log-penetration equation for air filtration with discussion on constant 'k'. Also elaborate the various mechanisms of separation behind filter sterilization.

B) Discuss in details the relevance of Placket-Burman method as a technique for medium optimization.

C) What will happen to oxygen transfer time from an individual gas bubble if Henry coefficient halves its value? Assume k_La remains constant. (4,4,2)

7.You are operating a 100000 litre bioreactor with a working volume of 80000 litres to produce a diagnostic enzyme. Your product is produced by a recombinant Gram-positive spore-forming bacterial species, *Bacillus subtilis*. Hence, it is necessary to meet the specification that the maximum probability of release of the recombinant organism into the environment through the spent medium is 0.001. The final bacterial concentration at the end of the production process is 6.5×10^9 cells per ml. The culture is passed through a continuous sterilizer at 135°C prior to downstream processing. Calculate the retention time required at 135 °C in the sterilizer to meet the required specifications. Universalgas constant: $R = 1.9878$ cal K^{-1} mol^{-1}. Typical values of sterilization constants:

Micro-organism	"Activation energy" E	Sterilization constant A
	(kcal/mol)	(min^{-1})
B. subtilis	68.7	9.50×10^{37}
vegetative cells	< 20	1.20×10^{21}

(10)

x-x-x