Exam.Code:0909
Sub. Code: 6708

1079

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 Unit.

x-x-x

I. Attempt the following:-

a) What is $Y_{x/s}$?

b) Define the term 'D'.

c) What is X_{go}? Write an expression for it.

d) How are biochemical reactions different from chemical reactions?

e) Define coefficient of viscosity.

f) Define limiting substrate.

g) Describe product classes based on the relationship between product formation and the growthphase. Give at least one product example per class.

h) Discuss the concept of repeated fed-batch culture.

i) Define aseptic operation and containment.

j) Justify the importance of HTST concept. (10x1)

UNIT – I

II. List main factors involved in scale-up and scale-down. Discuss the suitability of constant P/V and constant k_La approaches for a scale-up of shear sensitive culture. Discuss how sterilization process is scale dependent and how it results in the nutrient degradation. (3,4,3)

III. a) How does the type and nature of organism affect bioreactor design? Discuss the difference between microbial and animal cell bioreactors in terms of design.

b) Describe the growth-associated and non-growth associated product formation in fermentation process (preferably giving a generalized equation). (6,4)

IV. Write the material balance equation for a CSTBR with a neat diagram. Describe how recycling in a chemostat improves the production. (10)

P.T.O.

UNIT – II

V. 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. Universal gas constant: R = 1.9878 cal K^{-1} mol^{-1}. Typical values of sterilization constants:

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

(10)

VI. a) Outline the major considerations for developing SIP and CIP facilities in a fermentation industry.

b) Briefly describe important components of a fermentation medium. What factors one need to consider while formulating fermentation medium for commodity chemicals/enzymes? (5,5)

VII. a) Give reasons for foam formation during fermentations. Enlist desirable features for a substance to be used as ideal antifoam.

b) What will happen to oxygen transfer time from an individual gas bubble if Henry coefficient halves its value? Assume k_La remains constant. (6,4)

x-x-x