Enrollment No: _____

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech Mid Semester Exam

Semester: VI | **Date: (29/01/2024)**
Subject Code: (203144353) | **Time: (1hr: 30min)**
Subject Name: (Bioprocess Engineering) | **Total Marks: 40**

Sr. No.		Marks
Q.1	**(A) Five One line Questions**	**05**

a) Schematically represent the generalized material balance across a System.
b) Schematically represent the energy balance across a system.
c) Draw the microbial growth profile and indicate the different Phases in terms of specific growth rate (μ_d).
d) In Industries, what does $N_f = 0.1$ imply, where N_f is the final number of contaminants after sterilization?
e) What is the ideal chemostat equation for substrate consumption?

(B) Five Fill in the blanks **05**

One distillery industry is producing 100 m^3 ethanol in a chemostat using cane molasses containing 50 % w/w sugar by *S. cerevisiae*. The characteristics of yeast are given below: $\mu_m = 0.04$ h-1, $K_s = 3$ g. L^{-1}, $Y_{X/S} = 0.04 g.g^{-1}$, $Y_{P/S} = 0.5$ $g.g^{-1}$. The initial substrate concentration is 1000 g/L

a) The D_{max} value of the system is_____. 1

b) The steady-state biomass concentration is_____. 1

One distillery industry is producing 500 m^3 ethanol in a chemostat using cane molasses containing 45% w/w sugar by *S. cerevisiae*. Ethanol fermentation is a growth-associated product. The characteristics of yeast are given below: $\mu_m = 0.04$ h^{-1}, $K_s = 3$ $g.L^{-1}$, $Y_{X/S} = 0.04 g.g^{-1}$, $Y_{P/S} = 0.5$ $g.g^{-1}$. The initial substrate concentration is 2000 g/L. At steady state, calculate the following:

c) The D_{max} value of the system is _____ 1

d) The steady-state biomass concentration is _____ 1

e) The steady-state ethanol concentration is _____ 1

Q.2 **Attempt any four (Short Questions)** **12**

1) What are the two types of sterilization processes? Draw the Temperature (°C) vs. Time (h) profile of a batch sterilization process, indicating the different phases.

2) Define the Decimal Reduction time.

   Prove $\boldsymbol{D} = \frac{2.303}{k_d}$, where D is the decimal reduction time.

3) What are the selection criteria for an air filter? Give two examples of commonly used air filters.

4) Schematically represent the different types of reactors based on mode of operation. Indicate the input, output, and accumulation for each.

5) What is the difference between Doubling time and Generation time? Explain it with the help of an equation.

Q.3 **Attempt any two questions** **08**

1) What is Depth Filtration?
   Assuming the necessary parameters, derive an expression/equation for the filter efficiency "**E**".

2) What is sterilization? What are the effects of an unsterile media? Mathematically represent the different phases of sterilization (draw the graph) using the Arrhenius equation.

3) What is Monod's equation and state its limitation. Represent the linear representation of the model. Plot the linear graph and indicate which kinetic parameters can be calculated from this graph.

Q.4 1) What is the principle for Continuous Sterilization? Describe the working of any one type of Continuous sterilizer. **05**

2) What is a CSTR? Assuming necessary boundary conditions, prove that for a CSTR **μ=D**. For a CSTR, consider the first-order reaction A → Product, and derive the equation for space-time (τ), also called the performance equation. **05**

OR

2) Write short notes (include sketches) on the following: **05**
   Airlift reactor, Bubble column reactor, Equation for Microbial Product formation.

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