

BIOPROCESS TECHNOLOGY

(BIOT 5241)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group - A

1. Answer any twelve:

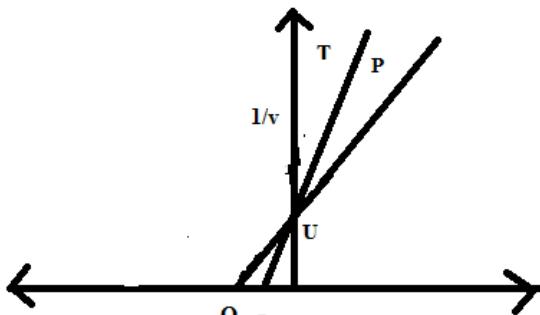
 $12 \times 1 = 12$

Choose the correct alternative for the following

(i) Lower value of Michaelis constant signifies

- Increased substrate affinity of the enzyme
- Reduced substrate affinity of the enzyme
- Decreased enzyme reaction rate
- None of the above

(ii) Identify the type of enzyme inhibition shown in the graph:



(a) Competitive inhibition (b) Non-Competitive inhibition
(c) Uncompetitive inhibition (d) Substrate inhibition

(iii) Wash out in steady state fermentation occurs when

- dilution rate is less than maximum specific growth rate
- dilution rate is higher than the maximum specific growth rate
- cell concentration reaches the maximum
- specific growth rate is maximum

(iv) The dissolved oxygen concentration in the medium below which the microbial system becomes oxygen limited is called

- Saturation level (b) Critical level
- Optimum level (d) None of the above

Fill in the blanks with the correct word

(xi) Both K_m and V_{max} are affected by the inhibition factor in this type of enzyme inhibition _____.

(xii) _____ condition happens when dilution rate is higher than the maximum specific growth rate.

(xiii) _____ is defined as the time taken at a given temperature to eliminate at least 90% of the exposed microorganisms.

(xiv) Del factor is defined as _____.

(xv) An example of probiotic is _____.

Group - B

2. Decarboxylation of glyoxalate(S) by mitochondria is inhibited by malonate(I). Using the following data obtained in batch experiments, determine the following:

S , mM		0.25	0.33	0.4	0.5	0.6	0.75	1
V , mM/h	$I=0$ mM	1.02	1.39	1.67	1.89	2.08	2.44	2.5
V , mM/h	$I=1.26$ mM	0.73	0.87	1.09	1.3	1.41	1.82	2.17

(i) What type of inhibition is this?
(ii) Determine the constants V_{max} , K_m' and K_I

[(CO2)(Analyse, Compute/HOCQ)]

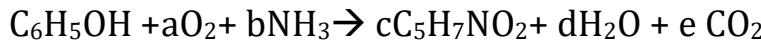
$$(6 + 2 + 2 + 2) = 12$$

3. (a) What is immobilization of enzymes? How many different types of immobilization techniques are there? [(CO2)(Remember/LOCQ)]
 (b) Differentiate between surface immobilization and entrapment method of immobilization? [(CO2)(Remember/LOCQ)]
 (c) What is Thiele modulus? [(CO2)(Remember/LOCQ)]

$$(2 + 4) + 4 + 2 = 12$$

Group - C

4. Aerobic degradation of phenol by a mixed culture of organisms in industrial effluent can be represented by the following reaction.



(i) Determine a,b,c,d, and e if RQ= 0.8.
 (ii) Determine the yield coefficients Y_{x/O_2} and $Y_{x/s}$.
 (iii) Determine the degree of reduction for the substrate and bacteria.

$$\begin{aligned} &[(CO3)(Calculate/LOCQ)] \\ &(5 + 4 + 3) = 12 \end{aligned}$$

5. (a) Derive the equation for optimum dilution rate(D_{opt}) for cell productivity (DX). [(CO4)(Remember/LOCQ)]
 (b) Differentiate between a chemostat and turbidostat. [(CO4)(Remember/LOCQ)]

$$8 + 4 = 12$$

Group - D

6. A 15 m³ chemostat is operated at a dilution rate of 0.1 h⁻¹. A continuous direct steam injection steriliser with a flash cooling is utilised for medium sterilisation. The temperature of the holding section for the medium sterilisation is maintained at 130°C. The contaminant concentration in the raw medium is 10⁵ per ml. An acceptable contamination risk is one organism in every three months. The activation energy for thermal death and Arrhenius constant are estimated to be 288.5 KJ/ gmol and 7.5×10³⁹h⁻¹, respectively. The inner diameter of the pipe of the steriliser is 12 cm. Determine the length of the holding section assuming Damkohler number to be 50.

[(CO5, CO6)(Calculate/HOCQ)]

$$12$$

7. (a) Define (i) *Defined media* for fermentation (ii) *Technical media* for fermentation. [(CO4)(Remember, /LOCQ)]
 (b) Describe the working principle of continuous sterilisation using heat exchanger. [(CO5)(Understand/LOCQ)]

$$4 + 8 = 12$$

Group - E

8. (a) “Mixed microbial culture is more suitable for biological treatment of wastewater”—Justify the statement. [(CO6)(Analyse/LOCQ)]
 (b) List the factors those affect alcohol fermentation process. [(CO6)(Remember/LOCQ)]

$$6 + 6 = 12$$

9. A distillery unit produces 100 m^3 of absolute alcohol in a chemostat from cane molasses (containing 45% w/w sugar) containing *S. Cerevisiae*. The characteristics of the yeast are as follows: $\mu_{\max} = 0.05 \text{ hr}^{-1}$, $K_s = 2 \text{ g/L}$, $Y_x/s = 0.05$, $Y_p/s = 0.5$, $S_0 = 200 \text{ gm/lit}$. Find the volume of the reactor and amount of cane molasses required per day.

[(CO6)(Calculate/HOCQ)]

12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	50	12.5	37.5