

**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.

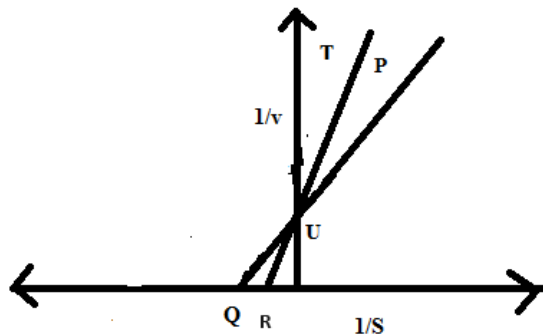
Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Lower value of Michaelis constant signifies
(a) Increased substrate affinity of the enzyme
(b) Reduced substrate affinity of the enzyme
(c) Decreased enzyme reaction rate
(d) 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
(a) dilution rate is less than maximum specific growth rate
(b) dilution rate is higher than the maximum specific growth rate
(c) cell concentration reaches the maximum
(d) specific growth rate is maximum
- (iv) The dissolved oxygen concentration in the medium below which the microbial system becomes oxygen limited is called
(a) Saturation level
(b) Critical level
(c) Optimum level
(d) None of the above

- (v) Continuous sterilization is better over Batch sterilization due to
 (a) Protection of nutrient value (b) Easier automatic control
 (c) Decrease in sterilization time (d) All of the above
- (vi) In sterilization process, spore of which of the following organism is considered as control?
 (a) *Bacillus subtilis* (b) *Clostridium botulinum*
 (c) *Bacillus stearothermophilus* (d) *Aspergillus niger*
- (vii) Which of the following reaction contribute in the decrease of nutrient value during sterilization
 (a) Brownian movement (b) Dehydrogenation
 (c) Dehydration (d) Millard type Browning Reaction
- (viii) Molasses and corn steep liquor are usually used as
 (a) Carbon source for large scale industrial fermentation process
 (b) Carbon source for small scale industrial fermentation process
 (c) Mineral source for large scale industrial fermentation process
 (d) Mineral source for small scale industrial fermentation process
- (ix) D value in sterilization of fermentation media is known as
 (a) Time to kill 90% of organism (b) Thermal death temperature
 (c) Time to kill 10% of organism (d) Thermal death point
- (x) Anaerobic respiration by yeast results in the production of
 (a) Wine and Beer (b) Carbon -di oxide
 (c) Alcohol (d) All 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=0mM	1.02	1.39	1.67	1.89	2.08	2.44	2.5
V, mM/h	I=1.26mM	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? [[C02](Remember/LOCQ)]
 (b) Differentiate between surface immobilization and entrapment method of immobilization? [[C02](Remember/LOCQ)]
 (c) What is Thiele modulus? [[C02](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.

$$\text{C}_6\text{H}_5\text{OH} + a\text{O}_2 + b\text{NH}_3 \rightarrow c\text{C}_5\text{H}_7\text{NO}_2 + d\text{H}_2\text{O} + e\text{CO}_2$$

 (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. [[C03](Calculate/IOCQ)]
(5 + 4 + 3) = 12
5. (a) Derive the equation for optimum dilution rate (D_{opt}) for cell productivity (DX). [[C04](Remember/LOCQ)]
 (b) Differentiate between a chemostat and turbidostat. [[C04](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. [[C05, C06](Calculate/HOCQ)]
12
7. (a) Define (i) *Defined media* for fermentation (ii) *Technical media* for fermentation. [[C04](Remember, /LOCQ)]
 (b) Describe the working principle of continuous sterilisation using heat exchanger. [[C05](Understand/LOCQ)]
4 + 8 = 12

Group - E

8. (a) "Mixed microbial culture is more suitable for biological treatment of wastewater"—Justify the statement. [[C06](Analyse/IOCQ)]
 (b) List the factors those affect alcohol fermentation process. [[C06](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: $\mu_{\max} = 0.05 \text{ hr}^{-1}$, $K_s = 2 \text{ g/L}$, $Y_{x/s} = 0.05$, $Y_{p/s} = 0.5$, $S_o = 200 \text{ gm/lit}$. 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