2016

BIOPROCESS TECHNOLOGY
(BIOT5203)

Time Allotted: 3 hrs   **Full Marks: 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.*

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: **10 × 1 = 10**

   (i)   Which of the following is best to sterilize heat labile (heat unstable) solution?
         (a) Dry heat   (b) Autoclave
         (c) Membrane filtration   (d) Pasteurization

   (ii) Ethylene Oxide is a highly toxic agent which destroys microorganisms by a process called _____
         (a) cavitation   (b) oxidation
         (c) osmosis   (d) alkylation.

   (iii) The most frequently used liquid chemical sterilant is
         (a) alcohol   (b) peracetic acid
         (c) glutaraldehyde   (d) formaldehyde.

   (iv) Which of the following is a limitation in an autoclave?
         (a) It takes too long to sterilise
         (b) It can't inactivate virus
         (c) It can't inactivate endospores
         (d) It will destroy heat labile materials.

(v) Which of the following is bactericidal?
    (a) Membrane filtration   (b) Ionisation radiation
    (c) Freeze drying   (d) Deep-freezing.

(vi) For the enzyme substrate reaction, the rate of disappearance of substrate is given by
$-r_A = \frac{1760[A][E_0]}{6+[A]}$, mol/m3.s. What are the units of the two constants?
    (a) s-1, mol/m3   (b) mol/m3.s, mol/m3
    (c) mol/L, s-1   (d) none.

(vii) The phenomenon in which substrates are used in a sequential manner is known as
    (a) trans-substrate genesis   (b) dialism
    (c) diauxic growth   (d) multiplicity.

(viii) 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.

(ix) Which of the following is not correct for the Monod model and the Michaelis Menten Model?
    (a) The Michaelis Menten Model was derived from a curve fitting exercise
    (b) The Michaelis Menten model was derived from an analysis of the mechanism of microbial growth
    (c) The Monod model was derived from an analysis of the mechanism of microbial growth
    (d) All of the above.

(x) An example of an unsteady state reactor is
    (a) Fed batch reactor   (b) Continuous reactor
    (c) Batch reactor   (d) All of the above.

Group - B

2. The following data were obtained from enzymatic oxidation of phenol by phenol oxidase at different phenol concentrations.

S, mg/L	10	20	30	50	60	80	90	110	130	140	150
v, mg/(L.h)	5	7.5	10	12.5	13.7	15	15	12.5	9.5	7.5	5.7

  i. What type of inhibition is this?
  ii. Determine the constants V_m, K_m and K_{Si}.
  iii. Determine the oxidation rate at [S]= 70mg/L.

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3. (a) An inhibitor I is added to the enzymatic reaction at a level of 1.0g/L. The following data were obtained for K_m= 9.2g/L

v, g/(L.min)	0.909	0.658	0.493	0.40	0.333	0.289	0.227
S, g/L	20	10	6.67	5	4	3.33	2.5

  (i) Is the inhibitor competitive or non-competitive?
  (ii) Find K_I

  (b) Write a short note on enzyme immobilization.

9 + 3 = 12

Group - C

4. *Pseudomonas sp* has a mass doubling time of 2.4h when grown on acetate. The saturation constant using this substrate is 1.3g/L and cell yield on acetate is 0.46gcell/g acetate. If we operate a chemostat on a feed stream containing 38g/L acetate, find the following:
  (a) Cell concentration when the dilution rate is one-half of the maximum
  (b) Substrate concentration when the dilution rate is $0.8D_{max}$
  (c) Maximum dilution rate
  (d) Cell productivity at $0.8D_{max}$

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5. Aerobic degradation of an organic compound by a mixed culture of organisms in waste water can be represented by the following reaction.
$$C_3H_6O_3 + aO_2 + bNH_3 \rightarrow cC_5H_7NO_2 + dH_2O + eCO_2$$
  I. Determine a,b,c,d and e, if $Y_{x/s}$ =0.4gX/gS.

II. Determine the yield coefficients of cell on oxygen and cell on ammonia.

III. Determine the degree of reductions for substrate, bacteria and RQ for the organisms

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Group – D

6. (a) Define sterilization.
   (b) Briefly describe the various techniques of sterilization used in industrial production processes?
   (c) Is there any role of antibacterial agents in media sterilization?
   (d) Define Del factor in sterilisation.

2 + 6 + 3 + 1 = 12

7. (a) It is desired to pasteurise 240 lit/min milk in a continuous pasteuriser by heating to 71.5°C for sufficient time to achieve a 12 D reduction in number of microorganisms. An existing pasteuriser of 55 mm ID and 30 m long, fed from a plate heat exchanger is available for the duty. Will it provide sufficient holding time. Density and viscosity of milk are 1010 kg/m^3 and 6.5×10^{-4} Pa-s and inactivation rate constant at 71.5°C is 1.84 sec^{-1}.

   (b) Describe the method of sterilisation of air.

9 + 3 = 12

Group - E

8. (a) Define (i) Genetic instability (ii) Segregation instability

   (b) Describe a process of Baker's yeast production in industry? How active dry Baker's yeast is produced from fresh yeast.

2 + (7+3) = 12

9. What fraction of the cells undergoing division will generate a plasmid free cell if (i) All cells having 40 plasmid at division. (ii) All cells have enough plasmid DNA for 40 copies, but one half of the plasmid DNA is in the form of dimer and 1/5th in the form of tetramer. (iii) Half of the cells have 10 copies of the plasmid and half have 70 copies (the average copy number is 40 as in case (i).

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