BIOPROCESS AND PROCESS INSTRUMENTATION
(BIOT 4143)

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

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one 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 alternative for the following: **10 × 1 = 10**

(i) Which of the following influence Heat sterilization of media
(a) Number of organisms (b) Kind of organisms
(c) Type of media (d) All of the above.

(ii) Bourdon tube is used for the measurement of gauge pressure of
(a) Gas (b) Liquid fluid
(c) Solid (d) Both (a) and (b).

(iii) 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

(iv) The highest feasible temperature for batch sterilization is _____ .
(a) 124°C (b) 120°C
(c) 122°C (d) 121°C

(v) For the enzyme substrate reaction, the rate of disappearance of substrate is given by
$-r_A = \frac{1760[A][E_0]}{6+[A]}$, $mol/m^3.s$. What are the units of the two constants?
(a) s^{-1}, mol/m^3 (b) mol/L, s^{-1}
(c) $mol/m^3.s$, mol/m^3 (d) none.

(vi) The growth of cells become oxygen limited when the dissolved oxygen concentration becomes
(a) More than critical oxygen concentration in medium
(b) Less than critical oxygen concentration in medium
(c) More than saturated oxygen concentration in medium
(d) Less than saturated oxygen concentration in medium.

(vii) Rate of a reaction is a function of
(a) reaction time
(b) concentration, reaction time
(c) concentration, temperature
(d) temperature.

(viii) Which of the following is not true at steady state
(a) OTR=OUR
(b) $D=\mu_g$
(c) $D=\mu_{net}$
(d) $F_{in} \neq F_{out.}$

(ix) Bacterial growth curve is obtained by plotting
(a) number of cells versus time
(b) number of spores versus time
(c) log of number of cells versus time
(d) log of number of cells survived versus time.

(x) The dilution rate, D is defined as(where F = volumetric flow rate, V_R = total volume of culture in the reactor and μ specific growth rate)
(a) F/V_R
(b) V_R/F
(c) μ/F
(d) F/μ.

Group – B

2. Urea dissolved in aqueous solution is degraded to ammonia and CO_2 by the enzyme urease immobilized on surface of non-porous polymeric beads. Conversion rate is controlled by transfer of urea to the surface of the beads through liquid film, and the conversion takes place on the surfaces of the beads. The following parameters are given for the system:
k_l=0.2cm/s, K_m=200mgL, V_m'=0.1mg urea/cm^2 support surfaces, S_b=1000mg urea/L.
(i) Determine the surface concentration of urea.
(ii) Determine tha rate of urea degradation under mass transfer controlled conditions.

6 + 6 = 12

3. At room temperature sucrose is hydrolyzed by the enzyme sucrose as follows:
Sucrose+ sucrase→products + sucrase.
Starting with sucrose (S_0= 1mol/m^3) and sucrase (E_0= 0.01mol/m^3) the following data are obtained in a batch reactor.

S, mol/m^3	0.68	0.16	0.006
t, h	2	6	10

Find the kinetic constants involved in the enzyme reaction.

12

Group – C

4. (a) Medium at a flow rate of 2 m^3 hr^{-1} is to be sterilised by heat exchange with steam in a continuous steriliser. The liquid contains bacterial spores at a concentration of 5×10^{12} m^{-3}. The activation energy and Arrhenious constant for thermal destruction of these contaminants 283KJ gmol^{-1} and 5.7×1039 hr^{-1}, respectively. A contamination risk of one organism surviving every 60 days' operation is

considered acceptable. The steriliser pipe has an inner diameter of 0.1 m, the length of holding section is 24 m. The density of medium is 1000 kgm^{-3} and viscosity is 3.6 kgm^{-1} hr^{-1}. What sterilization temperature is required if Damkohler number (Da) corresponding to this system is taken as 42?

(b) State the advantages of continuous sterilisation (Mention 3-4 points).

8 + 4 = 12

5. (a) State the methods of air sterilization.

(b) What is HTST sterilisation? How is it carried out in industry? What is the advantage of the process?

6 + (1 + 3 + 2) = 12

Group – D

6. The following data are obtained in oxidation of pesticides present in wastewater by a mixed culture of micro-organisms in a continuously operating aeration tank.

D, h^{-1}	S(Pesticides), mg/L	X, mg/L
0.05	15	162
0.11	25	210
0.24	50	250
0.39	100	235
0.52	140	220
0.7	180	205
0.82	240	170

Assuming the pesticide concentration in the feed wastewater stream as S_0=500mg/L, determine $Y^M_{x/s}$, k_d, μ_m and K_s.

12

7. *E. coli* have a maximum respiration rate, q_{o2max}, of about 240mgO_2/gX.h. It is desired to achieve a cell mass of 20gX/L. The k_la is 120h^{-1} in a 1000L bioreactor. A gas stream enriched in oxygen is used which gives a value of C*= 28mg/L. If oxygen becomes limiting, growth and respiration slow and follow:

$$q_{o2} = \frac{q_{o2max}}{\frac{0.2mg}{L} + C_L} C_L$$

Where C_L is the dissolved oxygen concentration in the fermenter. What is the C_L when the cell mass is at 20g/L?

12

Group – E

8. (a) What are the advantages of radiation method for temperature measurement.

(b) Explain the working principle of Membrane-type dissolved oxygen electrodes using a galvanic cell with a diagram.

6 + 6 = 12

9. (a) What is the use of inclined tube manometer?

(b) Explain the working principle of pH meter.

6 + 6 = 12

Department & Section	Submission Link
BT	https://classroom.google.com/c/MjQyMDU4ODMyNzg3/a/Mjc1OTEyMjE1Njk5/details