M.TECH/BT/2ND SEM/BIOT 5241/2019
BIOPROCESS TECHNOLOGY
(BIOT 5241)

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 alternative for the following: **10 × 1 = 10**

(i) Del Factor' is represented as
(a) ln No/Nt   (b) $A. e^{-E/RT}$ (c) E/RT^2 (d) kN.

(ii) Which of the following organism is used as design organism for sterilization program
(a) *B. amylolaqueficiens*
(b) *B. anthrax*
(c) *B stearotherompilus*
(d) *T. aquaticus.*

(iii) 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.

(iv) The kinetic parameter/s that is/are affected during uncompetitive inhibition is/are
(a) V_{max}, K_m (b) V_{max} (c) K_m (d) none of the above.

(v) 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.

(vi) 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.

(vii) When glucose is the sole carbon source in the medium for any bacterial inoculum, the lag period is expected to be
(a) prolonged   (b) very short   (c) no change   (d) data insufficient.

(viii) When the cells grow on lysis products of the lysed cell, it is known as
(a) trans-substrate genesis   (b) dualism
(c) diauxic   (d) cryptic growth.

(ix) A higher *Km* value of Michaelis- Menten equation means
(a) greater affinity of enzyme to substrate
(b) lower affinity of enzyme to substrate
(c) unaffected with the substrate bonding
(d) lower dissociation constant value.

(x) The maximum specific growth rate of an organism depends on
(a) medium composition   (b) temperature
(c) pH   (d) all of these.

Group – B

2. (a) An inhibitor I is added to the enzymaztic reaction at a level of 1.0g/l. The following data were obtained for Km= 9.2g/l. Find K_I for competitive inhibition.

v, g/(L.min)	0.909	0.658	0.493	0.4	0.333	0.289	0.227
S, g/L	20	10	6.67	5	4	3.33	2.5

(b) Derive Hanes-Wolf linear equation for the above reaction.

        7 + 5 = 12

3. (a) What are the advantages of immobilization technique.

(b) Discuss the various techniques of enzyme immobilization.

        4 + 8 = 12

Group – C

4. The following date were obtained in a chemostat for the growth of E. aerogenes on a glycerol limited growth medium.

D, h⁻¹, Dilution rate	0.05	0.1	0.2	0.4	0.6	0.7	0.8	0.84
S, mg/ml, glycerol concentration	0.012	0.028	0.05	0.1	0.15	0.176	0.8	9.00
X, mg/ml, cell concentration	3.2	3.7	4	4.4	4.75	4.9	4.5	0.5

S_0 = 10mg/ml.

For this system estimate the values of K_s, μ_m, $Y^M_{x/s}$, maintenance coefficient (m_s).

        12

5. The following data were obtained for the effect of temperature on the fermentative production of lactic acid by a strain of *Lactobacillus delbruekii*. From these data calculate the activation energy for this process.

Temperature, °C	40.4	36.8	33.1	30	25.1
Rate constant, mol/L.h	0.014	0.0112	0.0074	0.0051	0.0036

12

Group – D

6. 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 283 KJ gmol^{-1} and 5.7×10^{39} 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 42?

12

7. (a) State three criteria for formulation of fermentation media.

   (b) Differentiate between Defined media and Technical media for microbial growth?

   (c) Describe the method of continuous sterilization of media by continuous steam injection and flash cooling.

3+ 3 + 6 =12

Group – E

8. An inoculum is prepared in lab with 95% plasmid containing cell and 5% plasmid free cell in a 2 litre reactor with a total cell population of 2×10^{10} cells /ml. If this innoculum is used for a 1000 litre reactor and achieve a final population of 4×10^{10} cells/ml. If $\mu_+ = 0.69$hr^{-1}, $\mu_- = 1$hr^{-1}, P=0.0002, predict the fraction of plasmid containing cell.

12

9. (a) Explain the purification steps included in recovery of penicillin from fermentation broth.

   (b) "Mixed microbial culture is more suitable for biological treatment of wastewater"—Justify the statement.

6 + 6 = 12