Group - D

6.(a) What are the operating parameters and major considerations of membrane bioreactors?

(b) Write down the application of trickling filter in waste water treatment.

6 + 6 = 12

7.(a) What is solid state fermentation? Write down the different requirements for solid state fermentation bioreactor and plant and animal cell bioreactors in brief.

(b) What are the bioreactor considerations for an immobilized cell system?

(2 + 5) + 5 = 12

Group - E

8. What are the different control system for a bioreactor? Write down the working principles of each of them.

(4 + 8) = 12

9.(a) How can we monitor and control the level of dissolved oxygen in a bioprocess?

(b) Write down the mechanism for monitoring and control of temperature and pH.

6 + 6 = 12

M.TECH/BT/2ND SEM/BIOT 5204/2017

ADVANCES IN BIOREACTOR DESIGN,DEVELOPMENT AND SCALE UP
(BIOT 5204)

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 x 1=10**

(i) A reactor may be assumed as plug flow if Reynolds number is
(a) less than 2100 (b) more than 4100
(c) in between 2100 & 4100 (d) none of these.

(ii) If Thiele parameter, ϕ, is greater than 3, the reaction is
(a) mass transfer controlling
(b) reaction rate controlling
(c) molecular diffusion controlling
(d) intra-particle diffusion controlling .

(iii) Low flow rate of a gas is measured by
(a) rotameter (b) orifice meter
(c) wet gas meter (d) thermo-anemometer.

(iv) Cell suspension is a non-Newtonian fluid of the type
(a) Bingham plastic (b) Pseudo plastic
(c) Dialant (d) none of these.

(v) Volumetric mass transfer coefficient K_{La}, for bubble column is given as a function of
(a) P/V (b) V_{gs}
(c) Re_l (d) combination of (a) and (b).

(vi) At small substrate concentration, Monod model simplifies to the rate equation of
(a) first order reaction (b) zero order reaction
(c) second order reaction (d) pseudo first order reaction.

(vii) The criterion for the selection of animal cell culture reactor is
(a) low shear rate (b) removal of toxic metabolites
(c) combination of (a) and (b) (d) high cell mass concentration.

(viii) A non-ideal reactor is characterised by
(a) residence time distribution (b) Peclet number
(c) combination of reactors (d) segregated model.

(ix) The scale up criterion for a CSTR to be used for animal cell culture is based on
(a) geometric similarity
(b) equal Power Volume ratio
(c) equal tip velocity
(d) equal impeller based Reynolds number.

(x) Microbial fermentation is best carried out for high yield of cell mass by
(a) plug flow reactor
(b) batch reactor
(c) back-mixed reactor
(d) fluidized bed reactor.

Group - B

2.(a) A human being (75 kg) consumes about 6000 kJ of food per day. Assume that the food is all glucose and that the overall reaction is

$$C_{16}H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O, -\Delta H_r = 2816\ kJ$$

Find man's metabolic rate in terms of mole of oxygen used per m^3 of person per second. Density of human body is 1050 Kg/m^3.

(b) What is critical oxygen concentration? What are the factors that affect volumetric mass transfer coefficient?

8 + (1 + 3) = 12

3.(a) Enzyme E catalyzes the transformation of reactant A to product R as follows :

$$A \rightarrow R, \quad -r_A = \frac{200 C_A C_{EO}}{2 + C_A} \frac{mol}{liter.\min}$$

If we introduce enzyme (C_{E0} = 0.001 mol/liter) and reactant (C_{A0} = 10 mol/liter) into a batch reactor and let the reaction proceed, find the time needed for the concentration of reactant to drop to 0.025 mol/liter. Note that the concentration of enzyme remains unchanged during the reaction.

(b) The first-order reversible liquid reaction, A ⇌ R, C_{A0} = 0.5 mol/liter, C_{R0} = 0, takes place in a batch reactor. After eight minutes, conversion of A is 33.3 % while equilibrium conversion is 66.7%. Find the rate equation for this reaction.

6 + 6 = 12

Group - C

4.(a) After a batch fermentation, the system is dismantled and approximately 75% of the cell mass is suspended in the liquid phase (2L) while 25% is attached to the reactor walls and internals in a thick film of thickness 0.3cm. Work with radioactive tracers shows that 50% of the target product (intracellular) is associated with each cell fraction. The productivity of this reactor is 2g product/L at the 2L scale. What would be the productivity at 20,000L scale if both reactors had a height–to-diameter ratio of 2 to 1?

(b) What are the principles and criteria for scale up?

8 + 4 = 12

5.(a) The scale up volume of a reactor is 100 m^3 from 0.1 m^3 reactor with L/D = 3. The impeller diameter, D_I = 0.3 D. If the agitator speed of the small reactor is 600 rpm, what is the agitator speed of the bigger reactor, on the basis of equal mixing time, t_m?

(b) Describe the important features of a stirred tank reactor with respect to efficient mixing.

9 + 3 = 12