

B.Tech III Year II Semester (R09) Supplementary Examinations May/June 2017

BIOCHEMICAL REACTION ENGINEERING - II

(Biotechnology)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

1 Water at 25°C, enters an open heating tank at a rate of 10 kg h⁻¹. Liquid water leaves the tank at 88°C at a rate of 9 kg h⁻¹; 1 kg h⁻¹ water vapour is lost from the system through evaporation. At steady state, what is the rate of heat input to the system?

2 Write the mass balance, substrate balance equation for continuous reactor with recycle.

3 Aspergillus Niger is used to produce gluconic acid. Product synthesis is monitored in a fermenter; Gluconic acid concentration is measured as a function of time for the first 39 h of culture.

Time (h)	Acid concentration (g L ⁻¹)
0	3.6
16	22
24	51
28	66
32	97
39	167

- (i) Determine the rate constant.
(ii) Estimate the product concentration after 20 h.

4 Explain the kinetics of multi-substrate reactions.

5 Urea dissolved in aqueous solution is degraded to ammonia and CO₂ by the enzyme urease immobilized on surfaces of nonporous 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 surface of the beads. The following parameters are given for the system.

$$K_L = 0.2 \text{ cm/s}; K_m = 200 \text{ mg/L}$$

$$V'_m = \text{mg urea/cm}^2 \text{ support surface area-s}$$

$$S_b = \text{mg urea/L}$$

- (i) Determine the surface concentration of urea.
(ii) Determine the rate of urea degradation under mass transfer controlled conditions.

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- 6 (a) What is meant by intrinsic reaction rate constant?
(b) Derive an expression for the concentration profile of a substrate following first order kinetics and spherical geometry considering internal mass transfer.
- 7 Zymomonas mobilis is used to convert glucose to ethanol in a batch fermenter under anaerobic conditions. The yield of biomass from substrate is 0.06 g g^{-1} ; YPX is 7.7 g g^{-1} . The maintenance coefficient is $2.2 \text{ g g}^{-1} \text{ h}^{-1}$; the specific rate of product formation due to maintenance is 1.1 h^{-1} . The maximum specific growth rate of Z mobilis is approximately 0.3 h^{-1} . Five grams of bacteria are inoculated into 50 litres of medium containing 12 g L^{-1} glucose. Determine batch culture times required to:
- (i) Produce 10 g biomass.
 - (ii) Achieve 90% substrate conversion
 - (iii) Produce 100 g ethanol.
- 8 (a) Describe a bioreactor configuration for growth of plants cells.
(b) Which type of reactors is the world largest industrial fermenter? Why an air lift bioreactors helps you avoid damaging cell shear.

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