Roll No.

Paper Code: BT-21

M.Tech.
(SEM II) EVEN SEMESTER EXAMINATION 2015-16
BIOREACTOR ANALYSIS AND DESIGN

[Time: 3 hrs.]   **[Max. Marks: 100]**

Note. Attempt ALL questions. Each question carries equal Marks.

Q.1 Attempt any two of the following:-   **[10x2]**
   (a) How would you minimise mass transfer effects in heterogeneous reactions?

   (b) Differentiate between conventional and nonconventional bioreactor with an example.

   (c) Discuss Michaelis-Mentens equation and also give the equation for flat plate and spherical geometry.

Q.2 Attempt any two of the following:-   **[10x2]**
   (a) The reaction equilibrium for aerobic production of acetic acid from ethanol is

$$C_2H_5OH + O_2 \longrightarrow CH_3CO_2H + H_2O$$

   Acetobactor aceti bacteria are added to vigorously aerated medium containing 10 g l^{-1} ethanol. After some time the ethanol concentration is 2 g l^{-1} and 7.5 g l^{-1} of acetic acid is produced. How does the observed yield of acetic acid from ethanol compared with the theoretical yield?

   (b) Discuss *any two* of the following.
         i) Air lift bioreactor   ii) Fluidized bed bioreactor   iii) CSTR

   (c) What do you understand by Thiele modulus and observable Thiele modulus? Give Weisz's criteria.

Q.3 Attempt any two of the following:-   **[10x2]**
   (a) What are the strategies required for designing a bioreactor? Explain in detail.

   (b) Write short notes on *any two*.
         i) Stoichiometric yield   ii) Observed yield   iii) Gross yield

   (c) Define Mid- Point slope method by using central difference formula.

Q.4 Attempt any two of the following:-   **[10x2]**
   (a) Explain the response time profile of the following controller-
         i) Two position ON/OFF   ii) Proportional controller   iii) PID controller

   (b) Determine the substrate uptake in cell culture with extracellular product formation.

   (c) Determine the steady state shell mass balance equation.

Q.5 Attempt any two of the following:- **[10x2]**

    (a) Baby hamster kidney cells are immobilised in alginate beads. The average particle diameter is 5 mm. The bulk oxygen concentration in the medium is 8×10^{-3} kg m^{-3}, the rate of oxygen consumption by the cells is 8.4×10^{-5} kg s^{-1} m^{-3} of catalyst and the effective diffusivity of oxygen in the beads is 1.88×10^{-9} m^2 s^{-1}. Assume that the oxygen concentration at the surface of the catalyst is equal to the bulk concentration and that oxygen uptake follows zero order kinetics.

          (i) Are internal mass transfer effects significant?

          (ii) What reaction rate would be observed if diffusional resistances were eliminated?

    (b) Illustrate the concentration profile for First order kinetics and Zero order kinetics for both flat plate and spherical geometry.

    (c) Discuss the role of bioreactor in the production of food beverages and its application.