Q. Code: 766175

B.E./B.TECH. Degree Examination, December 2020

Fifth Semester

BT16502- Bioprocess Engineering

(Regulation 2016)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. A concentrated solution of the limiting substrate is added in fed-batch at a rate?

   a) Greater than the solution of the limiting substrate and the same medium used to establish the batch culture

   b) Less than the solution of the limiting substrate and the same medium used to establish the batch culture

   c) Equal to the solution of the limiting substrate and to the same medium used to establish the batch culture

   d) Negligible to the solution of the limiting substrate and to the same medium used to establish the batch culture

2. Which of the following factors are not involved in the scale-up process?

   a) Inoculum development

   b) Sterilization

   c) Temperature

   d) Medium design

3. The immobilization technique involving physical method is

   a) covalent bond formation dependent

   b) non-covalent bond formation dependent

   c) both (a) and (b)

   d) ionic bond formation dependent

4. The monod equation is based on which type of kinetics?

   a) Zero order kinetics

   b) First-order kinetics

   c) Second order kinetics

   d) First-zero order kinetics

5. Why Fed batch cultivation is so popular in biotech industries?

6. What is the Scale up criteria for bioreactors?

7. Mention the use of effectiveness factors.

8. How Dynamic simulation helps in bioprocess modeling?

PART B - (4 X16 = 64 marks)

9. (a) Consider a 1000-l CSTR in which biomass is being produced with glucose as the substrate. The microbial system follows a Monod relationship with u_m = 0.4 h^{-1}, K_S = 1.5 g/l, and the yield factor $Y_{X/S}$ = 0.5 g biomass/g substrate consumed. If normal operation is with a sterile feed containing 10 g/l glucose at a rate of 100 l/h: **(16)**

a. What is the specific biomass production rate (g/l-h) at steady state?

b. If recycle is used with a recycle stream of 10 l/h and a recycle biomass concentration five times as large as that in the reactor exit, what would be the new specific biomass production rate?

c. Explain any difference between the values found in parts a and b.

(OR)

(b) Penicillin is produced by *P. chrysogenum* in a fed-batch culture with the intermittent addition of glucose solution to the culture medium. The initial culture volume at quasi-steady state is V_0 = 500 l, and glucose-containing nutrient solution is added with a flow rate of F = 50 l/h. Glucose concentration in the feed solution and initial cell concentration are S_0 = 300 g/l and X_0 = 20 g/l, respectively. The kinetic and yield coefficients of the organism are u_m = 0.2 h^{-1}, K_S = 0.5 g/l, and $Y_{X/S}$ = 0.3 g dw/g glucose. **(16)**

a. Determine the culture volume at t = 10 h.

b. Determine the concentration of glucose at t = 10 h at quasi-steady state.

c. Determine the concentration and total amount of cells at quasi-steady state when t = 10 h.

d. If q_P = 0.05 g product/g cells h and P_0 = 0.1 g/l, determine the product concentration in the vessel at t = 10 h.

10. (a) Explain how in industrial-scale fermenters, oxygen supply and heat removals are designed. **(16)**

(OR)

(b) Consider the 10-l and 10,000-l tanks. Suppose that fully continuous operation is to be used, and *Feed* was fixed at 5 mg/L-s for both tanks, and D = 0.2 h^{-1} for each tank with fluid removal from the top. What fraction of the inlet substrate would be consumed in each tank? If the biomass yield coefficient were 0.5 g cells/g substrate and $Y_{P/X}$ = 0.1 g product/g cells, what would be the effect on volumetric productivity upon scale-up? **(16)**

11. (a) Critically evaluate the design of immobilized enzyme reactors – packed bed. **(16)**

(OR)

(b) Critically evaluate the Design of immobilized enzyme reactors –fluidized bed. **(16)**

12. (a) Discuss about modeling and simulation of bioprocesses. **(16)**

(OR)

(b) Explain different host vector system for recombinant cell cultivation strategies. **(16)**