Ref. No.: Ex/FTBE/T/324/2017

BACHELOR OF ENGINEERING (F.T.B.E.) EXAMINATION 2017

(3rd year, 2nd Semester)

Biochemical Engineering I

Time: 3hours (50 marks for each part) Use a separate Answer-Script for each part **Marks: 100**

Part-I

Answer any one question from Group A and any two from Group B **10+(20×2) = 50**

Group-A

1. Biomass present in a fermentation broth is to be separated by vacuum filtration. Filter and broth characteristics are given below.
   $A = 50m^2$, $\Delta P = 0.01N/m^2$, $C = 15kg/m^3$, $\mu = 0.003kg/m\text{-}s$, $\alpha = 2m/kg$.
   (i) If rate of filtration has a constant value of $dV/dt = 50$ l/ min, determine the cake and filter resistance at $t = 30$ min.
   (ii) Determine the filter surface area (A) required to filter 5000 l broth within 60 min with the same pressure drop across the filter. 10
2. Yeast cells are recovered from a fermentation broth by using a tubular centrifuge. Sixty percent of the cells are recovered at a flow rate of 12 l/min with a rotational speed of 4000 rpm. Recovery is inversely proportional to the flow rate.
   (a) To increase the recovery of cells to 95% at the same flow rate, what should be the rpm of the centrifuge?
   (b) At a constant rpm of 4000 rpm, what should be the flow rate to result in 95% cell recovery? 10

Group B

3. (a) DNA replication process is semi conservative-Justify the statement.
   (b) Write the role of different RNA.
   © What is the role of Plasmid?. How external gene is transfer to a host cell?
   (d) Briefly describe the cloning process. 5+5+5+5 = 20
4. (a) What are the advantages and disadvantages of enzyme and cell immobilization?
   (b) What are the different methods of enzyme immobilization?
   © Write some applications of immobilized enzymes. 6+9+5 = 20
5. (a) Write the advantages and disadvantages of genetically modified foods.
   (b) Establish the correlation of dialysis process on the basis of thermo dynamical point of view.
   (c) Briefly describe the Translation process. 6+5+9 = 20

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(3^{rd} Year -2^{nd} Semester)

Biochemical Engineering I

Time: 3 hrs. Full Marks : 50

Part – II (Answer question no. 1 and any two questions from the rest part; 10 + 20 x 2 = 50)

1. Answer the following :
   (a) Write the relation between impeller tip velocity and its rpm
   (b) (P_g / P) is less than 1 : explain
   (c) What is the relation between the aeration power requirement and the no of impellers?
   (d) Define dilution rate.
   (e) Mention the components of an oxygen delivery system for a fermentor
   (f) Why the volume of a fermenting vessel is divided into two segments i.e. head space and working volume ?
   (g) Why the sparging ring has almost the same diametr as that of impeller and it is set just below the impeller, why ?
   (1+2+1+1+1+2+2)

2. (a) With the help of neat sketch mention the geometrical design ratios recommended for the fabrication of fermenting vessels with different types of impellers.

   (b) For a single vessel continuous fermenting system, prove that actual growth rate of a microbe attainable is always less than the theoretically possible maximum growth rate. (8 + 12)

3. For a particular fermentation process the following data are available :
   (i) The viscosity and the density of the broth are 1200 kg/m^3 and 0.32 kg/m-sec, respectively. (ii) Speed of impeller and aeration rate are 100 rpm and 0.3 vvm, respectively. (iii) Dimensions of the fermenter equipped with two sets of standard flat blade turbines and four baffle plates are :
   (a) vessel diameter = 3m , (b) impeller diameter = 1.5 m (c) baffle plate width = 0.3m, (d) Liquid depth = 5m
   Also assume that (P_g /P) =$10N_a$ and [(P / V) $^{0.4}$ x $v_s^{0.5}$]1.5 =H_o, where P_g and P are power requirement for gassed and ungassed system, respectively (HP) , V is the volume of the liquid (m^3) , N_a is aeration no. , v_s is linear velocity of air based on the empty cross sectional area of tank (m/hr) and H_o (%) is gas hold up.
   Calculate (i) Power requirement when the vessel is acrated and (ii) hold up of gas bubbles in the medium. (20)

4. A bacterial fermentation is going on in a fermenting vessel . The required information about the fermentation is given as: The capacity of the vessel is 25 liter, H_L = 1.3 D_i ; D_i=D_t/3 ; (F/V) = 2.0 vvm and there are 2 sets of flat blade type of impellers inside the vessel. However, the production is to be transferred to a large scale fermenter of capacity 30,000 liter and therefore, you are supposed to estimate (F/V) and (v_s) for this larger fermenter. Actual working volume of each of the fermenter is 60% of the geometrical volume of each tank. All the physical properties of the broth are similar with those of pure water at room temperature. Also assume, (F/V) α $1/H_L^{2/3}$. (20)

5. Assuming power requirement per unit volume to be the scale up factor (basis), find the ratios of the following parameters in two different scales. Assume small scale fermenter to be of 80 liter volume and the large scale one of 10,000 liter capacity. The parameters to be considered are : P/ V , n , D_i , F, F/ V , nD_i. The terms bear normal meanings. (20)

6. (a) Give one example of each of axial flow and radial flow impeller. Name one antifoaming agent . With neat sketch explain mechanism of action of 'level' probe used to control foaming in bioreactors .Name components of pH control system of a bioreactor. State the objective of using condenser in a fermenter.
   (b) For a single vessel continuous fermenting system with recycle , prove the following relation:

$$\mu = D\{1 + \omega\,[1 - \frac{1 + \omega - (F_e / F)(X_e / X)}{1 + \omega - (F_e / F)}]\}$$, where the terms bear the usual meaning. [(2+1+ 3 + 1+1) + 12]